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Transportation Impact and Access Plan

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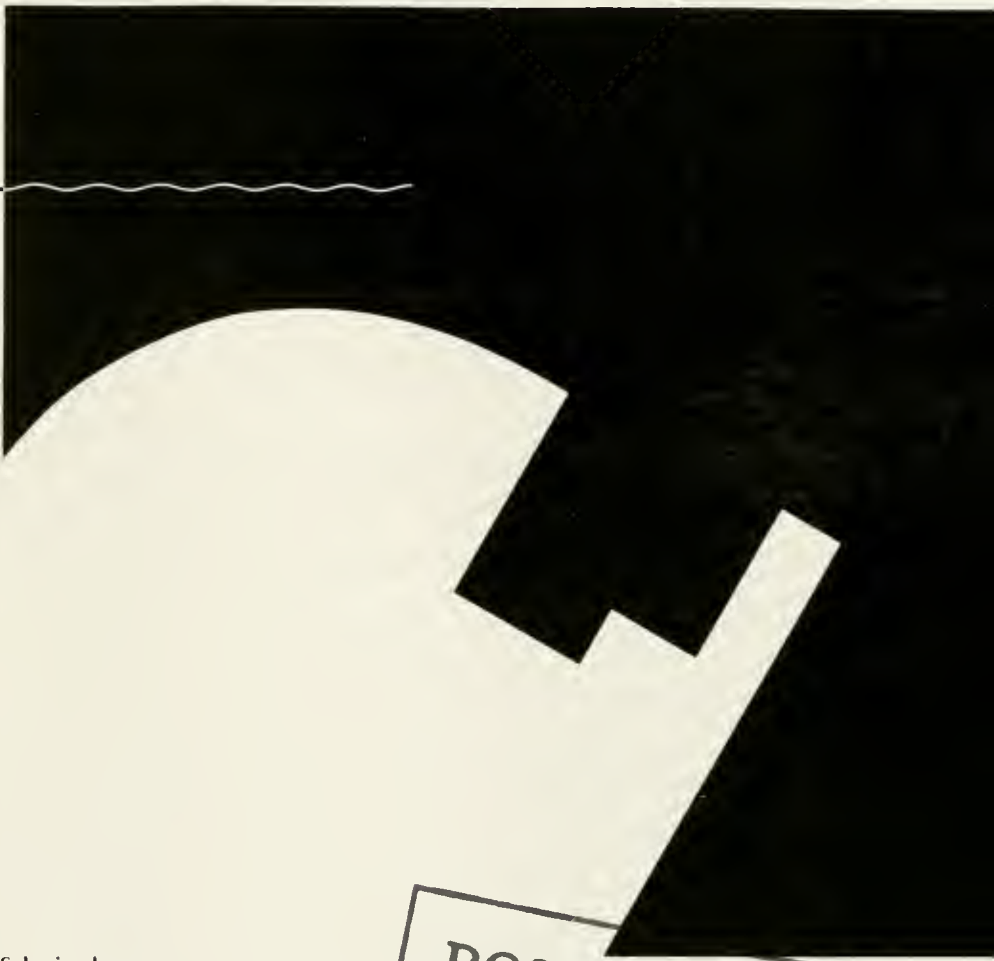

Submitted to:
The Boston Redevelopment Authority

Developers:
HBC Associates (Fan Pier)
The Boston Mariner Company (Pier 4)

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Fan Pier and Pier 4

Executive Summary

Transportation Impact and Access Plan

Prepared for the Boston Redevelopment Authority

March 1987

Preface: Boston's traffic is of growing private and public policy concern. Improvements have been planned by the city and state which can play an important role in easing the city's traffic burden. Major reconstruction and improvement programs to the public transit system are currently underway and promise an even better system which should increase usage. Federal funding commitments for major transportation projects in Boston, specifically the Third Harbor Tunnel, Central Artery depression, and Seaport Access Road projects seem closer than ever to final approvals. Boston's particular traffic and transportation opportunities require extensive planning and coordination, and represent a unique, important component of any private developer's planning. The Fan Pier and Pier 4 developers recognize the key place transportation planning has in the overall development process.

Aim: The Fan Pier and Pier 4 developers have conducted the most detailed transportation planning and mitigation analysis ever undertaken by a private project in Massachusetts. The developers are strongly committed to addressing the unique transportation issues presented by the projects themselves, and to working with the city and the state to solve the larger problems posed by the areas immediately surrounding the projects. The team feels that such coordinated efforts can have a lasting, positive impact on the entire scope of transportation issues facing Boston.

Specific Measures: Since the completion of the Fan Pier and Pier 4 Final EIR, efforts have focused on resolution of three major issues: construction access, traffic monitoring, and impact mitigation. These three analyses and other traffic data are presented in the Traffic Access Plan, the body of this report. Major conclusions are summarized below.

Construction Analysis. Early 1989 and 1990 will be the busiest periods for construction truck traffic and worker activity. This analysis shows there is no significant impact from construction activities at the project sites in these years. Furthermore, specific construction mitigation measures -- signals at the new Northern Avenue/Atlantic Avenue intersection, and the imposition of P.M. peak hour

parking restrictions on Atlantic Avenue, Summer Street, and Congress Street -- will significantly improve current conditions. Additionally, the use of designated truck routes, away from residential areas, will ensure that the South Boston neighborhood is protected from project construction truck traffic.

Traffic Monitoring. The purpose of the monitoring program is to measure future site-generated traffic and the future volume of traffic on roadways. Monitoring includes: site-generated traffic; demand created by adjacent or background development; and roadway capacity. Each year the volume of traffic generated by the site and volume of traffic at selected locations along the impact area will be reported to the city. In addition, the program will forecast four-year projections of site and area traffic volumes. The scope of this four-year access plan will include a re-analysis of project-generated travel demands as well as demands created by other developments in the area. The plan will also report on the status of public highway and transit improvements. Finally, the monitoring program will evaluate mitigation measures to minimize impacts.

Impact Mitigation. Extensive mitigation measures are proposed to reduce potential adverse traffic and parking impacts. These measures, outlined on the accompanying table, fall into seven major categories. Four of these mitigation categories were recommended in the Final EIR: Required Transit Services; Traffic Operations Improvements; New Roadway Capacity; and Demand/Reduction/Management. The other three actions were developed since the completion of the EIR:

- a set of measures designed expressly to mitigate construction impacts;
- a Transportation Management Association which will be responsible for installation and operation of all monitoring equipment necessary for the monitoring program;
- a set of demand reduction measures which may be implemented in order to meet the goals of the monitoring program; and

- potential financial contribution to mitigation measures required as enhancement to the mitigation program.

Conclusion: The Fan Pier and Pier 4 developers have created a monitoring and mitigation program that allows periodic updates of a Northern Avenue area wide transportation plan. This plan will closely study conditions at key intersections serving the area and propose measures for dealing with the conditions reported. In addition, an annual updated access plan will be prepared to analyze future traffic projections. The developers believe these measures are a responsible and effective approach to ensuring a successful traffic system for the area.

Summary of Mitigation Measures

Category	Mitigation Measure	Implementing Agency	Proponent Contribution
Required Transit Services	o Shuttle bus system	o MBTA	Assistance in operation planning, on-site improvements for boarding/alighting areas, and interim service contract prior to public operation
	o Suburban express bus system	o MBTA, Private bus operators	Assistance to operators for route planning completed
Traffic Operations Improvements	o Intersection-Related improvements	o BTD	Planning services for intersection design completed
	o Arterial-Related improvements	o BTD, MDC	Planning service has been completed for engineering and streetscape improvements
	o System-Related improvements	o BTD	Work with city to devise delivery vehicle scheduling policy
	o South Boston Transportation Study	o BTD	Partial funding of study has occurred
New Roadway Capacity	o Advance construction of links to Seaport Access Road	o BTD, MDPW	Planning services completed
	o South Boston Bypass Road	o MDPW, BTD	Planning services completed
	o Reopening of Dorchester Avenue	o BTD, MDPW, USPS	Planning services completed
Demand Reduction/ Management	o MBTA rapid transit improvements	o MBTA	Planning coordination with MBTA
	o Water shuttle	o MBTA, BRA, EOTC, Massport	Feasibility study completed. Boat landings and passenger facilities to be provided on site. Provision of promotional materials to tenants
	o Water taxi	o MBTA, BRA, EOTC	Sponsoring pilot demonstration program with interagency coordinating committee
	o Pedestrian access	o BTD, BRA, MDPW	Old Northern Avenue to have ample pedestrian environment funded by proponent on north side adjacent to Fan Pier and Pier 4
	o Agency coordination and liaison	o Various agencies, Fan Pier/Pier 4 developers	Provide continuing coordination with agencies

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* BRA = Boston Redevelopment Authority
BTD = Boston Transportation Department
CTPS = Central Transportation Planning Staff
EOTC = Executive Office of Transportation and Construction
Massport = Massachusetts Port Authority
MBTA = Massachusetts Bay Transportation Authority
MDC = Metropolitan District Commission
MDPW = Massachusetts Department of Public Works
USPS = United States Postal Service

Summary of Mitigation Measures
(continued)

Category	Mitigation Measure	Implementing Agency	Proponent Contribution
Construction-Related	o Designated truck routes to and from sites	o Project Developers	Construction contracts to prohibit use of South Boston neighborhood streets
	o Use of second shift to reduce maximum hourly truck volume	o Project Developers	Construction contracts to specify spreading of excavation over a 16-hour day
	o Limits on size of trucks	o Project Developers	Construction contracts to specify maximum capacity based on legal load limitations
	o Transit information for construction workers	o Project Developers	Developers to distribute transit route and schedule information to all construction contractors
Transportation Management Association (TMA)	o Monitoring traffic continuously	o TMA	Membership in and equitable financial support of TMA
	o Reporting to City	o TMA	Membership in and equitable financial support of TMA
Measures To Meet Monitoring Program Goals	o Promotion of flexible work hours	o Project Developers	Developers to encourage tenant employers to institute flexible work hours
	o Transit Incentives	o Project Developers, Tenant Employers	Information, marketing, pass sales and employer pass subsidies
	o Ridesharing promotion and matching	o Caravan, Tenant Employers, TMA	Membership and equitable financial support of TMA
	o Preferential carpool and vanpool parking location	o Project Developers	Developer to set aside parking spaces for carpools and vanpools
	o Different parking rates for carpools	o Project Developers	Developer to provide preferential rates for carpools
	o Sponsorship of vanpools	o Caravan, Tenant Employers, TMA	Membership in and equitable financial support of TMA
	o Hotel marketing, information and airport shuttle	o Hotel operators TMA	Coordination to promote use of project hotels by visitors to immediate area of project.
	o Parking restrictions	o City	
	o Channelization and Signal Improvements	o City	
	o Incident Response	o City	

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FAN PIER and PIER 4

TRANSPORTATION IMPACT

AND ACCESS PLAN

proposed for

CITY OF BOSTON
BOSTON REDEVELOPMENT AUTHORITY
and
BOSTON TRANSPORTATION DEPARTMENT

MARCH 1987

prepared by

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TRANSPORTATION IMPACT ASSESSMENT AND MITIGATION

INTRODUCTION

The purpose of the Transportation Access Plan is: to describe the use of existing roadway, parking, and transit facilities serving the South Boston area; to characterize existing state and city plans for upgrading these systems and facilities; to assess the effects of the Fan Pier and Pier 4 Developments on existing and future transportation systems in 1995 (completion of the developments); and to examine and identify implementation measures to mitigate adverse impacts. Additional descriptions, data and computations are presented in the Appendix.

Estimates of travel demands for the Fan Pier and Pier 4 Developments are based upon the proposed programmatic uses for the two projects. The results of three separate transportation analyses are presented in this report:

1. 1985 - Existing Conditions
2. 1995 - No-Build
3. 1995 - Completed Development of Fan Pier and Pier 4

Transportation networks assumed for each of the three analysis conditions are:

1. 1985 - Existing street and highway network
2. 1995 - The 1985 network plus addition of the Seaport Access Road and Third Harbor Tunnel portions of the I-90/I-93 project, plus Relocated Northern Avenue and the new Northern Avenue Bridge.

For the 1995 analysis year, transportation forecasts include demand from existing and likely new land uses in the northern commercial/industrial area of South Boston and in Downtown. For the purposes of this impact assessment, the Final Fan Pier/Pier 4 EIR Master Plans are examined.

The Transportation Impact Assessment and Mitigation portion of this Access Plan is organized into several major sections. These are listed below, along with the general content of each section.

Introduction. The Introduction includes general background information to set the context of the Traffic and Parking analysis, defines the study area and traffic analysis locations, and outlines the general methodology used in the traffic and parking analysis.

Description of the Environment. This section provides information on current transportation-related conditions within the study area. Three topics are discussed: (1) traffic conditions along streets, highways, and the main analysis locations; (2) the public transportation system, including rapid transit, local and express bus, commuter rail and commuter boat; and (3) parking facilities on or near the project sites.

Assumed Future Transportation System. Additions or improvements to the transportation system expected by 1995 have been included in the impact analysis. This section describes all roadway improvements expected to be constructed and open to traffic by 1995 and all transit improvements expected to be operational in 1995.

Probable Project Impacts. The Impacts section begins with an estimate of person and vehicular travel demands created by the projects in 1995. Trips from other background developments likely to be built are also estimated. Travel demand characteristics for both the projects and background developments have been estimated assuming that urban densities, parking conditions, and transportation service in the Northern Avenue area of South Boston will be similar in nature to those found in Boston's Central Business District. The distribution of trips to various geographic corridors around the site is then presented, followed by the identification of impacts on roadways, parking facilities, and the public transportation system. Several scenarios are analyzed, including 1995 with and without the projects, but in both cases with the Third Harbor Tunnel/Seaport Access Road portions of the I-90/I-93 project. In 1995, the Depressed Central Artery portion of the I-90/I-93 project is not included. Impacts during project construction are also discussed in this section.

Mitigation Measures. Based on project impacts, a comprehensive program of measures to mitigate these impacts is presented in three general categories: (1) Demand Reduction/Management, (2) Traffic Operations Improvements, and (3) New Roadway Capacity. Roadway, transit, and parking-related measures are discussed, along with the identification of the party responsible for implementation and, where possible, the probable effect on traffic operations within the study area.

FAN PIER AND PIER 4 DEVELOPMENTS

The Northern Avenue area immediately across the Fort Point Channel from Downtown Boston has, in recent years, been the subject of public and private interests as the next area of expansion for Boston. Within this area,

the proposed development of the Fan Pier and Pier 4 will create approximately 2.1 million square feet of office and retail space, 1,100 hotel rooms and 1,100 residential units, all to be constructed within the next nine years.

With the exception of parking, all of the proposed development on the Fan Pier represents new uses. The proposed Pier 4 Development site currently contains only Anthony's Pier 4 Restaurant and its associated parking area. Anthony's Pier 4 Restaurant will remain, but the existing parking facilities will be relocated below ground level to make room for the project. Table 1 summarizes the anticipated development plans for Full Build in 1995.

TABLE 1
Final EIR
Master Plan
Development
Program

Phase	Office (sq. ft.)	Retail (sq. ft.)	Hotel (rooms)	Residential (units)	Parking (spaces)
1995 Full Build					
Fan Pier	1,325,000	155,000	806	597	2,500
Pier 4	572,000	79,000	290	500	2,650
Total	1,897,000	234,000	1,096	1,097	5,150

The PDA Plan for Fan Pier land use varies slightly from the FEIR Master Plan. PDA office use is 1,405,750 square feet, retail use is 168,100 square feet, and residential units are 536. The hotel space remains at 806 rooms. The PDA level use changes result in increasing AM peak hour traffic by 28 vehicles and PM peak hour by 30 vehicles. This change is not significant enough to warrant reanalysis, and the access report is therefore based on the FEIR Master Plan.

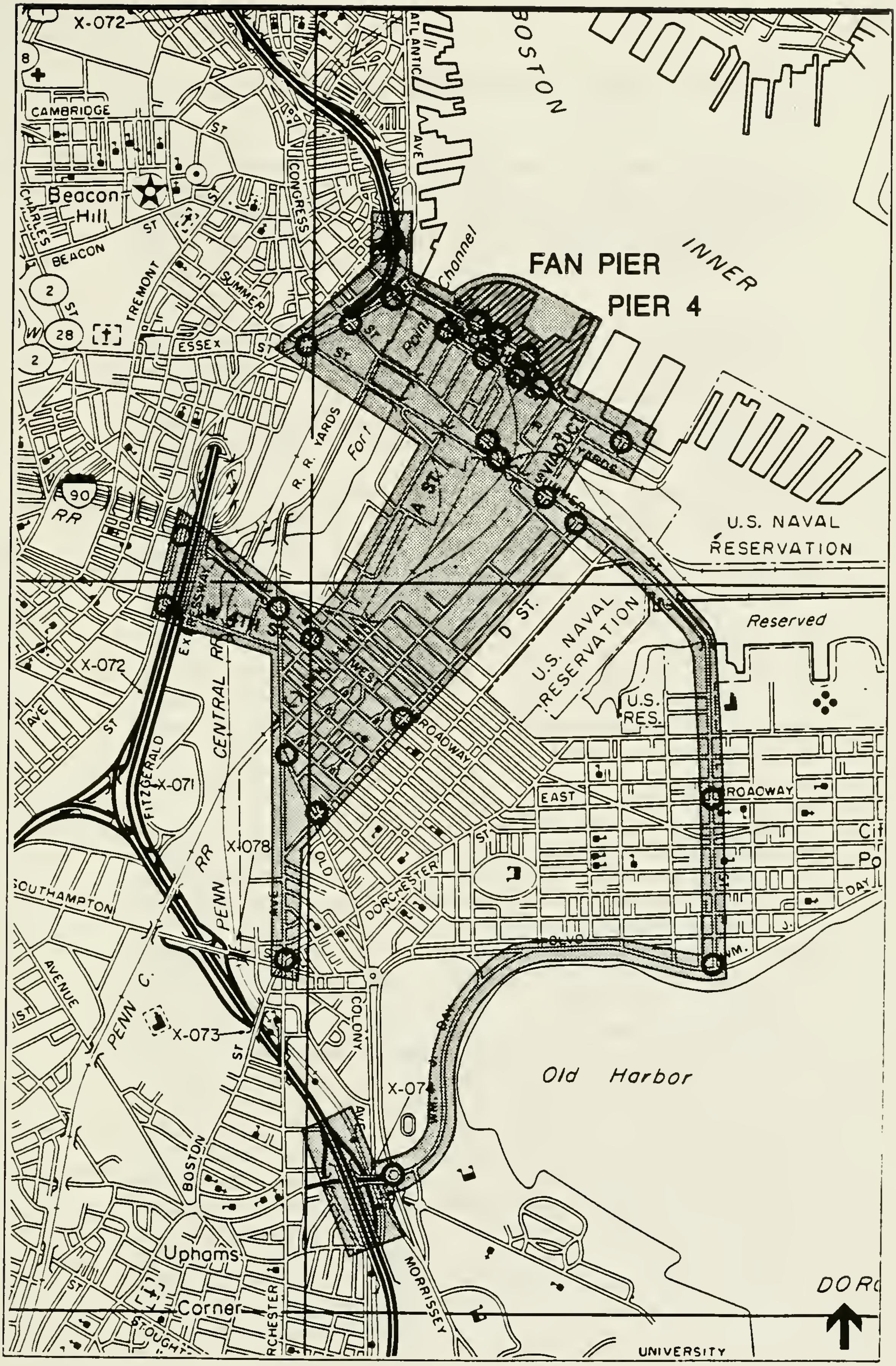
STUDY AREA

The transportation analysis encompasses a relatively large area of South Boston and adjacent sections of Downtown Boston as shown in Figure 1. The shaded area on the map represents the primary analysis area for the study. Twenty-seven key locations along the major commuter routes through this area have been chosen for analysis and are shown in Figure 1. Other streets and intersections will be impacted by the projects. However, the selected routes and analysis locations include those which are most seriously impacted, and thus provide adequate data for assessing project impacts

FIGURE 1
Traffic Study
Area

▨
Study Area

○
Analysis
Locations



and travel conditions expected on a typical commuting day.

Public transportation directly serving the site is currently limited to two local bus routes. The nearest rapid transit stations are located at South Station (Red Line) and Aquarium (Blue Line). Commuter rail and express bus services are also available from South Station.

Land use within the study area is a mix of commercial, office, retail, residential, warehouse, and marine-related uses. The Fan Pier site is dominated by a large, inexpensive ($3.50 per day) commuter parking lot. Anthony's Pier 4 Restaurant and its related parking occupy the Pier 4 site. The immediate vicinity includes parking lots, the World Trade Center at Commonwealth Pier 5, industrial/warehouse properties, and vacant land. Commonwealth Flats, the Fish Pier, and the Boston Marine Industrial Park are situated to the east. Immediately across the Fort Point Channel is the financial district with the office, commercial, and retail developments of the Central Business District nearby. Much of the property along the Fort Point Channel in South Boston is changing in character due to development associated with the area's proximity to Downtown.

STUDY METHODOLOGY

The transportation access study was conducted in three distinct steps. Step I inventoried the existing travel demand characteristics in the area. The inventory included researching previous transportation reports as well as conducting new observations of area travel demands. Observations of traffic volumes were conducted at the locations shown in Figure 1 during the morning and evening peak travel hours. Roadway volumes were recorded over 24-hour periods. (Detailed traffic count data are included in the Appendix). In addition, data for transit line performance and ridership were researched from MBTA files to identify existing and future transit service. MBTA data were supplemented by conducting field observations of Red Line and Green Line performance and ridership during peak weekday travel periods. Detailed survey forms and results are included in the Appendix. Certain data available from previous planning studies and EIRs in the area were verified by means of recounts at selected locations in 1985. The existing transportation network served as a base condition for subsequent analysis.

Step II of the study built upon the data base in Step I and established the framework for evaluating the transportation impacts of the proposed projects. In this step, travel demand forecasts for the proposed development projects were determined along with forecasted demands created by other likely future developments in the area. Estimates were made for both vehicular and public transit modes.

Forecasting travel demands to the entire South Boston development area was accomplished through recognition of several key factors that will influence travel behavior to and from the area in the future. First of all, the projects and background development programs will create a Downtown urban environment, vastly different from the sprawling almost suburban-like conditions found in the project area today. In this environment, parking supply will be limited and, since it will be underground or on structure, it will also be expensive. Also, public transit service to the area will be upgraded as another element of the entire South Boston urban development area infrastructure. Urban density, limited parking and better public transit service all contribute to an environment that is conducive to transit use for the trip to and from work. The travel demand analysis for these projects recognizes this and develops a transit and highway plan supportive of demand forecasts.

The final step in the analysis evaluated impacts of the projects on each element of the transportation system and identified measures necessary to mitigate any adverse transportation impacts.

It should be noted that the traffic analysis was conducted assuming that only the Third Harbor Tunnel/ Seaport Access Road elements of the I-90/I-93 project will be in place by the 1995 analysis year. The Depressed Central Artery portion of the I-90/I-93 project was not included because current construction timetables indicate all elements of the Artery will not be completed until three years after the 1995 analysis year.

The highway network represents a realistic condition for the 1995 analysis year and reflects EOTC's expected construction timetables. The Seaport Access Road and Third Harbor Tunnel provide direct connection to and from the project area with two proposed interchanges. Travel to the projects from the Massachusetts Turnpike, Southeast Expressway and Logan Airport/North Shore can occur entirely on new limited-access highways as a result of this construction program. Impacts on local

streets are thus minimized. While the Depressed Central Artery is a key element in the Commonwealth's Transportation Master Plan, the Fan Pier/Pier 4 Project area is well served with the Seaport Access Road/Third Harbor Tunnel.

DESCRIPTION OF THE ENVIRONMENT

The transportation system in the vicinity of the study area is highly developed, consisting of regional highways, arterial and local streets, commuter and local bus routes, rapid transit services, and commuter rail and boat services.

STREET SYSTEM

Access/Circulation

The street system in South Boston and adjacent sections of Downtown consists of both local and arterial streets and limited access highways. Regional routes serving the area include:

- The Central Artery - the major north-south roadway through Downtown. It is a limited access highway located at the western edge of the study area, providing access to I-93, the Tobin Bridge (Route 1 to I-95) and Storrow Drive; the Southeast Expressway; and the Massachusetts Turnpike Extension.
- Southeast Expressway - a limited access highway providing the major route to the south. It is the continuation of the Central Artery south of the Dewey Square Tunnel.
- Massachusetts Turnpike Extension - a limited access highway providing the major route to the west. It terminates at the Southeast Expressway/Central Artery at the western boundary of the study area.
- Morrissey Boulevard - a major arterial roadway extending south from Columbia Road providing an alternative route to the Southeast Expressway and southern suburbs.

Major roadways providing access to the site across the Fort Point Channel from Downtown and throughout the entire area include:

- Northern Avenue - provides direct access to the site and is a major connection across the Fort Point Channel between South Boston and Downtown (at

Atlantic Avenue). In South Boston, it provides access to Commonwealth Pier 5 (World Trade Center), Fish Pier 6 and the Boston Marine Industrial Park.

- Summer Street - another major connection between Downtown (at South Station) and South Boston.
- Congress Street - the third connection across the Fort Point Channel providing access to the western part of South Boston from Downtown.
- L Street/W.J. Day Boulevard - an important South Boston collector street also currently providing a commuter route between the site (and Downtown) and the Southeast Expressway and Morrissey Boulevard at Columbia Road. L Street represents the continuation of Summer Street from the vicinity of the Reserved Channel south to Day Boulevard.
- D Street - another South Boston street which currently serves as a commuter route for traffic to the south. It runs from Summer Street just east of the Viaduct to Dorchester Avenue.
- A Street - a South Boston street which provides commuter access to the Southeast Expressway via West Fourth Street and to the Massachusetts Turnpike Extension via the West Broadway Bridge.

A more detailed description of the street system is provided in the Appendix.

Existing Traffic Volumes

Mechanical and manual traffic counts were taken in March and April, 1985, and were supplemented with additional traffic volume data from the Central Transportation Planning Staff to form a 1985 base traffic flow network. Table 2 lists, for several locations, the 1985 average weekday daily traffic (AWDT), AM and PM peak hour traffic volumes, and the percent of daily traffic volume which the AM and PM peak hour traffic volumes represent. Existing daily volumes are also shown in Figure 2. Among the locations shown in Table 2, average daily traffic volumes along major routes range from a low of 8,300 vehicles per day on D Street to a high of 30,350 vehicles per day on the Summer Street Bridge.

TABLE 2
1985 Traffic Volume Summary

Location	1985 AWDT*	AM Peak Hour (vph)**	Percent of AWDT	PM Peak Hour (vph)	Percent of AWDT
Northern Avenue Bridge	17,700	1,520	8.6%	2,290	12.9%
Sleeper Street	5,400	310	5.7%	610	11.3%
Congress Street Bridge	10,500***	1,100	10.6%	780	7.5%
Summer Street Bridge	30,350	2,360	7.8%	2,110	7.0%
Broadway Bridge	29,950	2,050	6.8%	2,300	7.7%
West Fourth Street Bridge	12,200	950	7.8%	940	7.7%
Reserved Channel Bridge	17,750	1,580	8.9%	1,330	7.5%
D Street north of Cypher Street	8,300	750	9.0%	600	7.2%
East Broadway at L Street	11,900	640	5.4%	740	6.2%
W.J. Day Boulevard at I Street	21,400	1,510	7.1%	1,730	8.1%
Old Colony Avenue at D Street	25,900	2,480	9.6%	2,320	9.0%
Dorchester Avenue at Damrell Street	13,850	1,050	7.6%	1,180	8.5%

* AWDT - average weekday daily traffic.
** vph - vehicles per hour.
*** Estimate based on 1981 count.

FIGURE 2
Existing
Average
Weekday Daily
Traffic

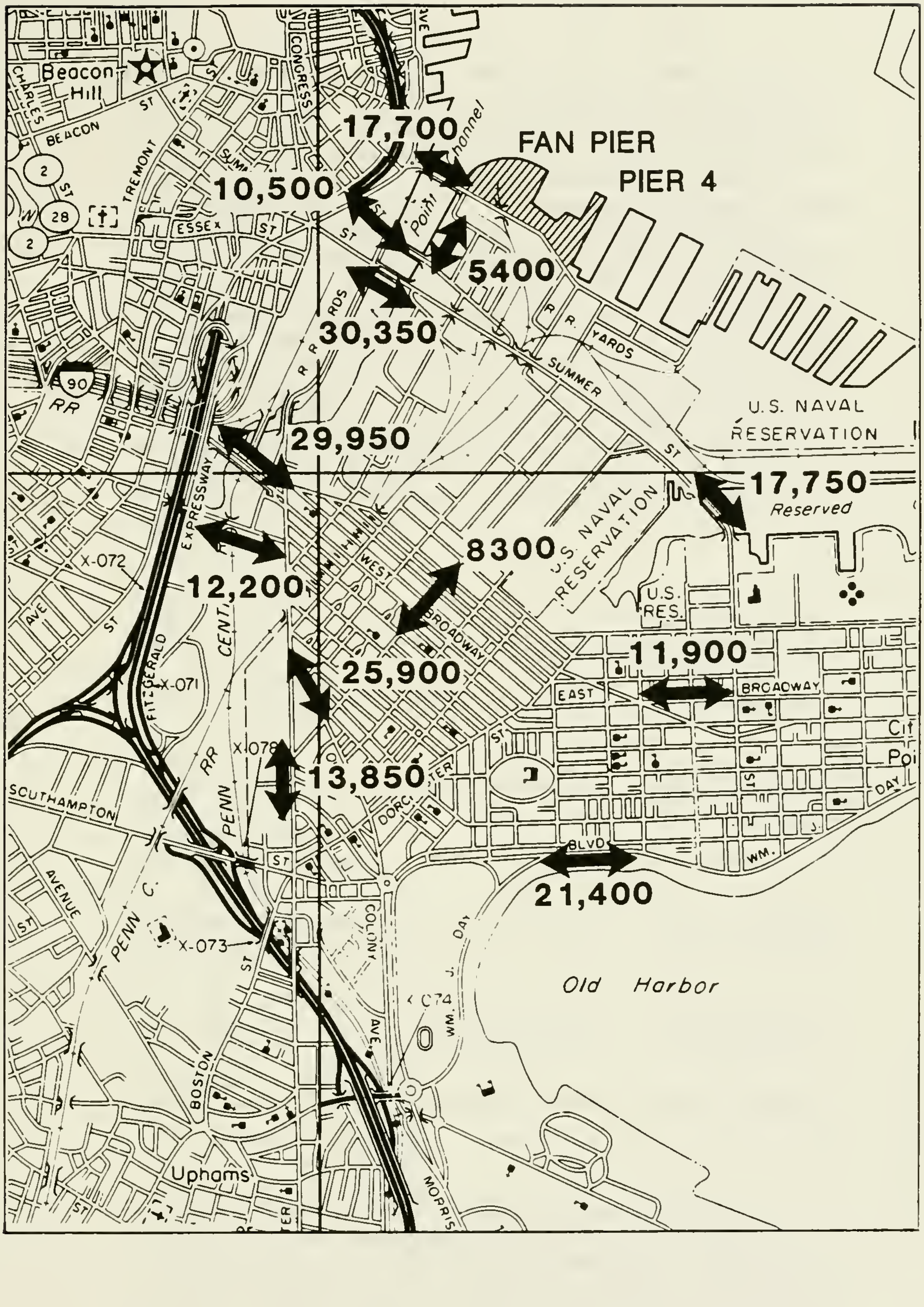


Table 3 shows peak hour directional distribution for various two-way roadways in the study area. The table lists the locations and the percent of the peak hour traffic in the dominant direction of flow. The highest directional flow is on Northern Avenue at Atlantic Avenue where 88 percent of the evening peak hour traffic is westbound (toward downtown). As shown earlier in Table 2, this roadway also has the highest percentage of daily traffic in the evening peak hour. L Street at East Broadway has the highest directional traffic flow in the AM peak hour, with 86 percent of the traffic in the northbound direction. The same location also shows high directionality in the evening peak hour, with 74 percent of the peak hour volume moving southbound. In contrast, West Broadway at Dorchester Avenue has evenly balanced directional distribution with only 51 percent westbound in the morning and 53 percent eastbound in the evening.

TABLE 3
Peak Hour
Directional
Distribution

Location	AM Peak Hour	PM Peak Hour
Northern Avenue at Atlantic Avenue	55% Eastbound	88% Westbound
Summer Street at D Street	62% Westbound	56% Eastbound
West Broadway at Dorchester Avenue	51% Westbound	53% Eastbound
Dorchester Avenue at Old Colony Avenue	68% Northbound	64% Southbound
W.J. Day Boulevard at L Street	78% Eastbound	69% Westbound
L Street at East Broadway	86% Northbound	74% Southbound

The peak hour directional distribution generally reflects travel toward Downtown in the morning and travel away from Downtown in the evening. A variation in this pattern is along Northern Avenue at Atlantic Avenue. Large commuter parking lots located on the Fan Pier and along Sleeper Street attract trips across the Fort Point Channel in the morning and generate trips in the opposite direction in the evening. A Central Artery northbound off-ramp on Atlantic Avenue south of Northern

Avenue and an on-ramp north of Northern Avenue reinforce this pattern.

Existing Levels of Service

Figures 3 and 4 show 1985 peak hour turning movements at the analysis intersections in the study area. Turning movement counts shown for the AM and PM peak hour are an important element in determining roadway operating conditions because they enable the analyst to assess the vehicle conflicts expected at intersections. These traffic volumes were analyzed to determine existing conditions and form the base upon which future traffic conditions are projected. Levels of service at each study location were calculated and are presented in Table 4. The procedure and criteria used for determining levels of service are described in the Appendix. Three key terms used in the table to describe operating conditions are defined below:

Level of Service. Level of service (LOS) is used to denote intersection operating conditions and is represented on a scale ranging from "A" at the highest level to "F" at the lowest level. Levels of Service "A" through "D" are generally considered acceptable while Levels "E" and "F" are not. At Level of Service "A" drivers experience little delay and intersections operate under free-flow conditions. Levels of Service "B" through "D" represent increasing amounts of delay and increasing numbers of vehicles which are stopped and may have to wait through more than one red signal. At Level of Service "E" the intersection is approaching capacity and processing the maximum number of vehicles possible. Long backups and queues of vehicles occur and many vehicles wait through more than one light cycle. Level of Service "F" results from volumes in excess of capacity and is characterized by jammed conditions. The increased volume results in forced-flow, stop and go traffic with intolerable congestion and delay.

Volume-to-Capacity Ratio. Volume-to-capacity (V/C) ratio is a term that is used to quantify the level of service ranges. It compares the volume actually being processed through an intersection to the theoretical maximum capacity of the location. If the volume exactly matches the capacity, the V/C ratio is 1.00 which falls at the upper end of LOS "E". If the volume is less than capacity, the V/C ratio is less than 1.00. If the volume is greater than capacity, the V/C ratio is greater than 1.00. The latter condition occurs when more traffic wants to pass through a location than can be handled by it, thereby resulting in the congestion and delay associated with LOS "F". Each LOS range is

FIGURE 3
Existing AM
Peak Hour
Volumes

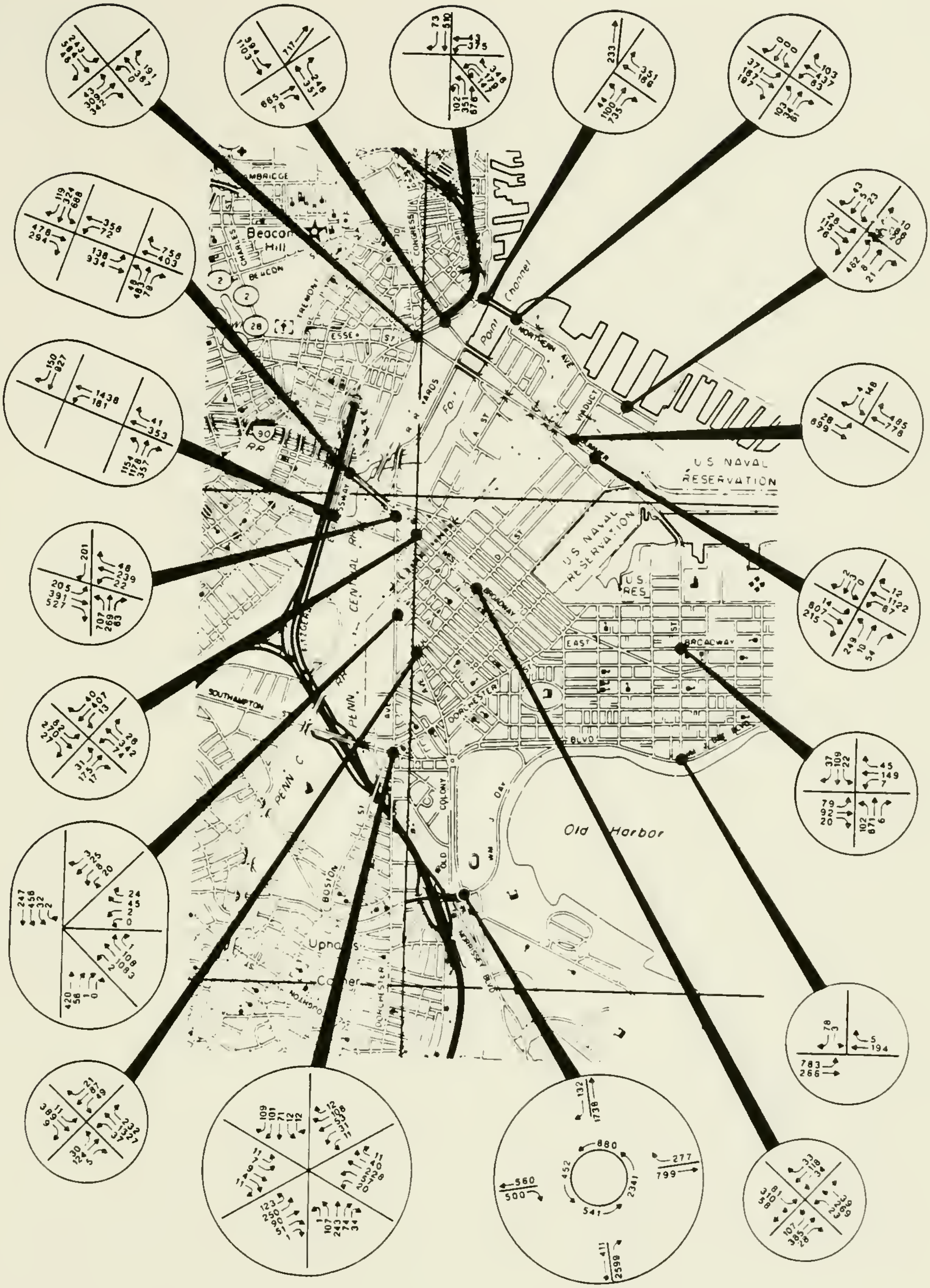
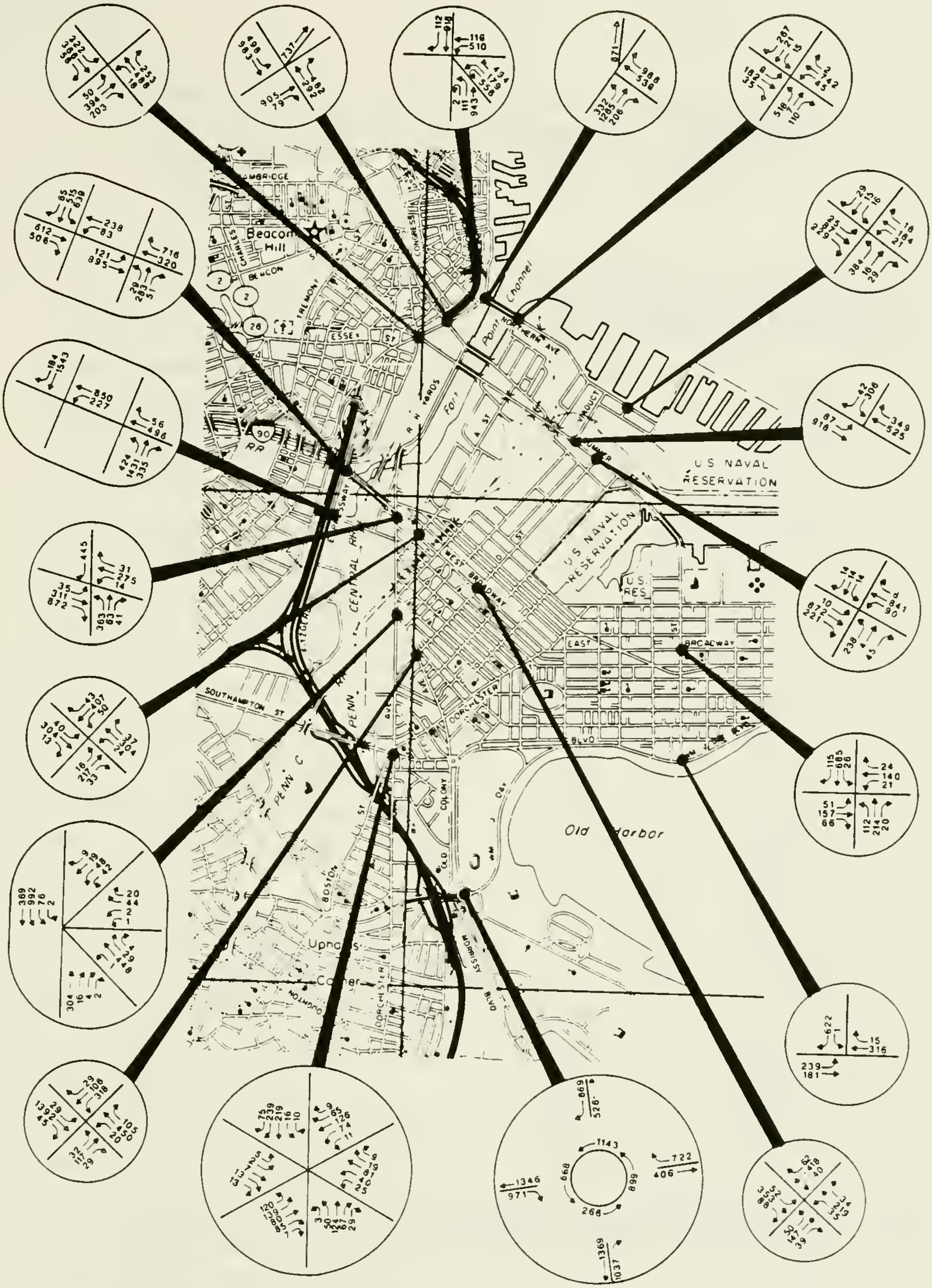


FIGURE 4
Existing PM
Peak Hour
Volumes



denoted by a V/C ratio range with the lower ratios denoting the better levels of service. The specific ranges associated with each LOS are given in the Appendix.

TABLE 4
Existing Levels of Service

Location	AM Peak Hour		PM Peak Hour	
	V/C*	LOS**	V/C	LOS
East Broadway/L Street	0.53	A	0.49	A
West Broadway/D Street	0.64	B	0.67	B
Old Colony Avenue/D Street	0.67	B	0.82	D
West Broadway/A Street	0.65	B	0.60	A
West Fourth Street/Frontage Road	0.74	C	0.68	B
East Berkeley Street/Albany Street	0.76	C	0.64	B
Herald Street/Albany Street	0.55	A	0.69	B
Summer Street/Viaduct	0.53	A	0.46	A
Summer Street/Atlantic Avenue	0.93	E	0.94	E
Northern Avenue/Atlantic Avenue***	0.61	B	0.91	E
Congress Street/Atlantic Avenue	0.83	D	0.88	D
Broadway Bridge/Frontage Road	0.75	C	0.60	A
Summer Street/D Street	0.66	B	0.62	B
Andrew Square	0.71	C	0.52	A
High Street/Atlantic Avenue	0.75	C	0.90	D
Old Colony Avenue/Dorchester Avenue	0.57	A	0.44	A
West Broadway/Dorchester Avenue	0.86	D	0.70	B
Northern Avenue/Ramp Street	149	D	143	D
Day Boulevard/L Street	352	B	251	C
Northern Avenue/Sleeper Street	242	C	0	E
Kosciuszko (Columbia) Circle	1.03	F	1.05	F

* Volume-to-capacity ratio (available reserve capacity for unsignalized intersections).

** Level of service.

*** Analyzed as a signalized intersection (even though it is not) due to operating characteristics of this location during peak hour conditions.

Available Reserve Capacity. Available reserve capacity (ARC) is a special term associated with unsignalized intersections. For these facilities, the major roadway

is assumed to have the right-of-way and each individual movement on the side street (right, left, or through) is analyzed for its maximum capacity based on approach volumes on the major roadway. The actual volume being processed for each movement is compared to its calculated capacity. The difference between capacity and actual demand is defined as the available reserve capacity and is used as the criterion for determining level of service. Each LOS is associated with a range of ARC values, as shown in the Appendix. The higher the ARC, the better the LOS. The ARC and LOS values attached to an unsignalized intersection normally apply to the most critical movement at that location, i.e., the one with the least amount of reserve capacity.

In the morning peak hour, two locations are operating near or at capacity. One location is the intersection of Summer Street and Atlantic Avenue which is operating at Level of Service "E" with a volume-to-capacity ratio of 0.93. The other location is the rotary at Kosciuszko Circle which is operating at a volume-to-capacity ratio of 1.03 for the northbound traffic along Morrissey Boulevard which forms a queue waiting to enter the rotary.

In the evening peak hour, these intersections operate at similar levels of service as in the morning peak hour. In addition, two other intersections also operate at Level of Service "E". These are the intersection of Northern Avenue and Atlantic Avenue and the intersection of Northern Avenue and Sleeper Street. Both are currently unsignalized intersections. One other location, High Street at Atlantic Avenue, is at the borderline between Levels "D" and "E".

The level of service calculation for Northern Avenue and Sleeper Street represents conditions for side street traffic trying to cross or enter the Northern Avenue flow. However, the level of service calculation for Northern Avenue and Atlantic Avenue was done as if the intersection were signalized. This is because the stop-sign control on Northern Avenue is ineffective during periods of heavy traffic. As a result, the conflicting flows of Northern Avenue traffic entering the northbound Central Artery ramp alternate crossing the intersection with Atlantic Avenue traffic. Queues form along both Atlantic Avenue and Northern Avenue. The signalized level of service analysis is the technique which produces results most closely representing the actual operating characteristics of the intersection.

Truck Traffic

Truck traffic using certain South Boston streets exists largely as a result of industrial uses located in the northern section. Table 5 shows truck traffic as a percent of approach traffic at several major intersections. Truck traffic tends to be heaviest in the morning peak hour. Several roadways with intersection approaches carrying more than 10 percent trucks in the morning include: Broadway, D Street, A Street, L Street, and Northern Avenue. In the evening, only D Street eastbound at Old Colony Avenue carries more than 10 percent trucks. Because of the negative impact of heavy truck volumes on intersection capacity, adjustments in level of service calculations were made for every intersection with any approach having more than 5 percent trucks.

Vehicle Speeds/Travel Times

Travel speeds provide a measure of performance that can be used to assess the effectiveness of streets to accommodate traffic volumes. Speed measurements were taken by a standard traffic engineering procedure called the "Floating Car Method." Travel speeds and delays along several key commuter routes in South Boston were measured by means of an observation car traveling in the traffic stream at a speed consistent with the flow of vehicles at any given time. Table 6 indicates the results, showing average speeds which were recorded in the peak direction on these roadways and which are representative of overall travel speeds. Spot speeds at specific points along the route may be higher or lower depending upon localized conditions.

The results of the corridor average travel speed study indicate that the A Street, L Street, and West Broadway corridors all experienced overall speeds less than 15 mph during peak periods. Average travel speeds lower than 15 mph were also observed on D Street during the afternoon peak period (3:30 PM to 6:00 PM). On the remaining streets, observed speeds were generally low, varying from 15 to 28 mph.

TABLE 5
Existing Truck Traffic Percentages at Selected Locations

Intersection and Approach	Percent Trucks	
	AM Peak Hour	PM Peak Hour
D Street/Summer Street		
D Street Eastbound	19	6
Summer Street Southbound	9	6
Summer Street Northbound	3	6
D Street/Old Colony Avenue		
Old Colony Northbound	2	5
Old Colony Southbound	4	3
D Street Eastbound	7	13
D Street Westbound	14	4
A Street/Broadway		
A Street Northbound	17	4
A Street Southbound	8	3
Broadway Eastbound	13	7
Broadway Westbound	13	4
Northern Ave./Atlantic Ave.		
Atlantic Avenue Northbound	6	4
Northern Avenue Westbound	18	N/A*
L Street/Broadway		
L Street Northbound	2	5
L Street Southbound	11	2
Broadway Eastbound	8	7
Broadway Westbound	6	5
D Street/Broadway		
D Street Northbound	2	3
D Street Southbound	8	3
Broadway Eastbound	6	4
Broadway Westbound	5	9

* Trucks not counted because of high volumes and lack of traffic control.

TABLE 6
Travel Speeds in Peak Direction

Roadway	AM Peak Hour (mph)*	PM Peak Hour (mph)
Summer Street	27	25
L Street	14	19
Congress Street	14	24
D Street	26	10
Northern Avenue	26	21**
West Broadway	12	14
A Street	13	6
Sleeper Street	17	17
Old Colony Avenue	28	11

* Average speed in the peak travel direction in miles per hour.

** Does not include delay at approach to Atlantic Avenue.

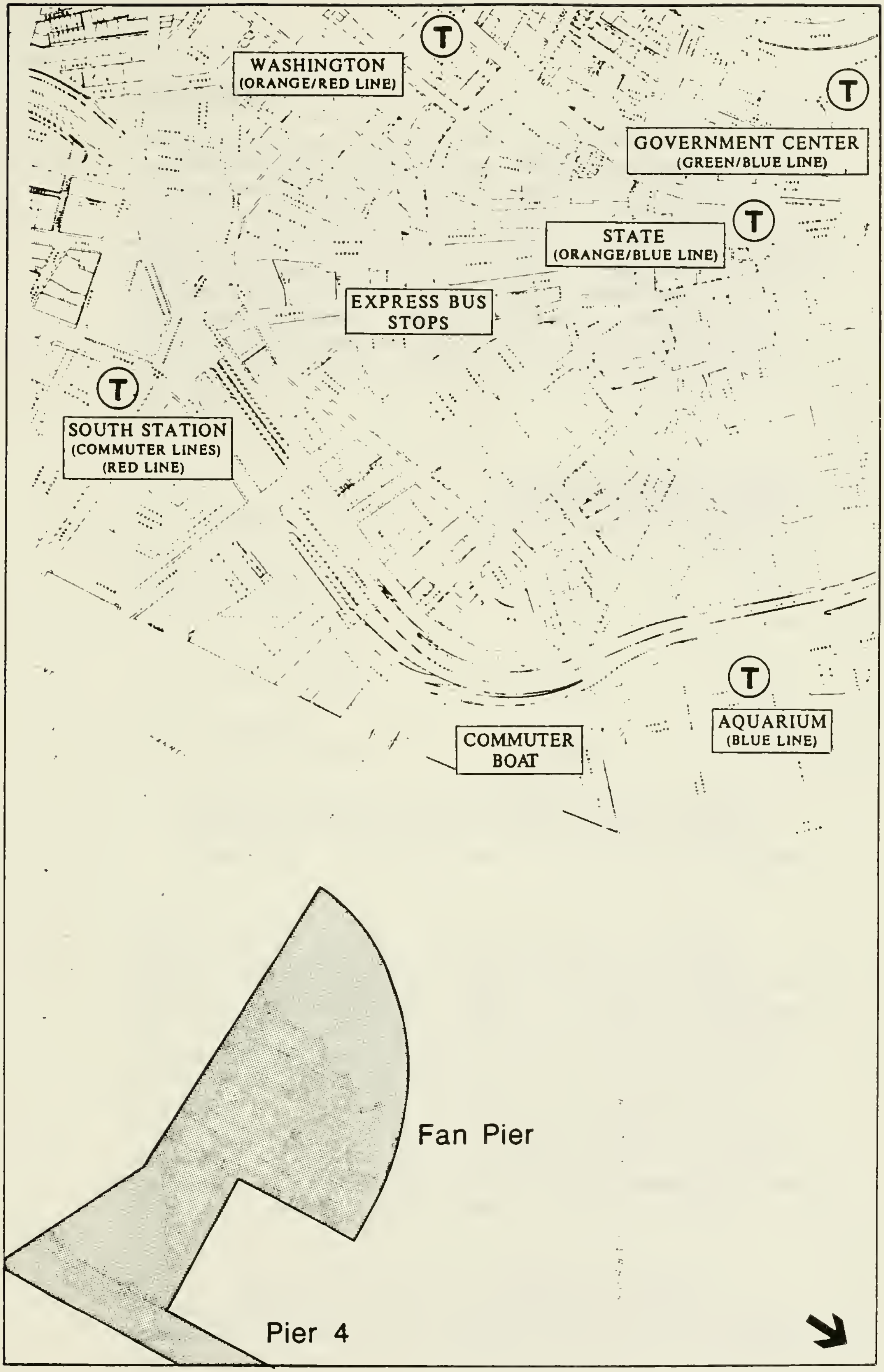
SOURCE: Field inventory for the Commonwealth Pier EIR, 1981. Traffic counts taken in 1981 and 1985 indicate little change in volumes and establish the validity of using the earlier data to represent existing conditions.

In addition to observing travel speeds, average travel times were recorded over selected alternative routes between the Fan Pier and Pier 4 sites and the Massachusetts Turnpike Extension and the Southeast Expressway. Average times and distances for five inbound routes from the south, for six outbound routes to the south, and for three outbound routes to the west were recorded and are reported in Table 10 of the Appendix. The routes studied include the major commuter routes through South Boston along L, D, and A Streets, and routes across the Fort Point Channel on Northern Avenue and Congress Street. These average travel times were considered in the assignment of future trips to the study area street system.

PUBLIC TRANSPORTATION SYSTEM

The sites of the proposed projects are accessible to public transportation. Figure 5 shows the existing facilities and services in the area. These include Red Line and Blue Line rapid transit, commuter rail, local and commuter bus, and commuter boat.

FIGURE 5
Public Transportation Facilities


T
WASHINGTON (ORANGE/RED LINE)
T
GOVERNMENT CENTER (GREEN/BLUE LINE)
T
STATE (ORANGE/BLUE LINE)
EXPRESS BUS STOPS
T
SOUTH STATION (COMMUTER LINES) (RED LINE)
T
AQUARIUM (BLUE LINE)
COMMUTER BOAT
Fan Pier
Pier 4

Rapid Transit

Pedestrian access to rapid rail transit lines from the proposed projects will involve walking distances greater than one-half mile as shown in Table 7. A Red Line station is located at South Station, while the Blue Line Aquarium Station is located at State Street and Atlantic Avenue (at the Marriott Long Wharf). Currently, walking distances between the sites and both stations are approximately equal. However, with the relocation of the Northern Avenue bridge, walking distance to the Aquarium Station will be increased by approximately 500 feet.

TABLE 7
Walking Distances Between the Sites and Rapid Transit Stations

	Walking Distance (feet)	
Site Location	South Station	Aquarium*
Sleeper Street/ Old Northern Avenue	2,400	2,950
Pittsburgh Street/ Old Northern Avenue	3,100	3,650
Pier 4 Entrance/ Old Northern Avenue	4,100	4,650

* Distances to the Aquarium Station are via the relocated Northern Avenue bridge and are approximately 500 feet longer than via the existing bridge.

The Red Line runs from Alewife Station in Cambridge through Downtown Boston to Andrew Station in South Boston. South of Andrew Station, the route divides with one branch terminating at Ashmont in Dorchester and the other going to Quincy and Braintree. Major commuter parking garages are provided at Alewife, Quincy Center, Quincy Adams (junction of Routes 3 and 128) and Braintree, while smaller parking lots are provided at North Quincy and Wollaston. Transfer points on the Red Line occur at the two stations north of South Station. Washington is the transfer point to the Orange Line, and Park Street is the transfer point to the Green Line.

The Blue Line runs from Wonderland in Revere on the north to Bowdoin just west of Government Center. Transfer points are at the two stops west of Aquarium. Orange Line transfers are made at State Street and Green Line transfers are made at Government Center.

In Table 8, rapid transit line capacities are calculated from the car capacities used by the MBTA for planning purposes, even though heavier passenger loads are often observed on the system. This conservative estimate of capacity shows that currently, despite a shortage of rolling stock, Red Line trains running through South Station can accommodate about 11,500 passengers in each direction in the peak hour. Trains through State Street Station on the Orange Line can carry 9,300 passengers in each direction. The Green Line can accommodate about 7,500 passengers on all branches combined west of Park Street, while the Blue Line can handle 6,600 riders. It should be noted that in preparing this Final EIR, a detailed study of Red Line and Green Line operations was conducted in the fall of 1986 and capacities for those lines are based upon actual operating conditions.

TABLE 8
Existing Rapid Transit Line Capacity Peak Hour Peak Direction

Line/Segment	Average Cars/ Train	Average Headway* (minutes)	Average No. of Trains	Car Capacity**	Line Capacity
Red Line/North Ashmont-Alewife Braintree-Alewife	4	4	15	180	10,800***
Red Line/South Alewife-Ashmont Alewife-Braintree Park-Quincy	4	3.75	16	180	11,520
Green Line/West Boston College Cleveland Circle Riverside Huntington Avenue	1.6****	1.67	36	130	7,500
Green Line/North Lechmere Service	1.33****	4	15	130	2,600
Orange Line/ North-South Oak Grove-Forest Hills	4	4	15	155	9,300
Blue Line Bowdoin-Wonderland	4	4	15	110	6,600

---

* Red and Green Line headways are based on observed system performance in fall 1986. Orange and Blue Line headways are based on schedules obtained from the MBTA.

** The MBTA uses these capacity estimates for planning purposes. Heavier loads can be carried and are often observed on the system.

*** Capacity is slightly lower than Red Line/South because the Quincy-Park run is not included.

**** Represents one-car trains on the Huntington Avenue Line and a mix of one and two-car trains on all other lines.

The MBTA periodically counts in-vehicle passengers at certain peak load point stations. On the Red Line, for example, the peak load points are Andrew and Charles. On the Blue Line, Aquarium is the peak load point. Table 9 compares current ridership with current capacity.

It should be noted that peak hour ridership does not generally occur uniformly over the peak hour. Instead, there may be surges over short periods of time. In such cases, trains become overcrowded, and some passengers are forced to wait for another train.

Another factor which affects the capacity of the system is equipment reliability . The Red and Green Lines have suffered from equipment malfunctions over the past several years. Such malfunctions disrupt the schedule of service and reduce system throughput. The result is lower effective capacity than would be available under operations not suffering such disruptions. For this reason, the Red and Green Line capacities shown in Tables 8 and 9 are based not on schedules but on actual system performance in fall, 1986. The planned improvements described later in this section should increase system reliability dramatically. They include longer trains and platforms, more cars, renovation of the existing vehicle fleet, track and signal reconstruction. The effect will be more consistent achievement of the scheduled system capacity.

Local Bus Service

The MBTA currently operates two bus routes which directly serve the proposed project sites. These are Route 6, Army Base-Haymarket and South Station (via Northern Avenue), and Route 7, City Point-Downtown (via Northern Avenue). Figure 6 shows these routes within the study area. Both routes provide service between the project sites and South Station where there are connections to the Red Line, Commuter Rail and private commuter buses. Route 6 also stops at the Aquarium Blue Line Station and Haymarket Station with connections to the Orange and Green Lines and North Shore express buses.

TABLE 9 Existing Rapid Transit Ridership PM Peak Hour Outbound

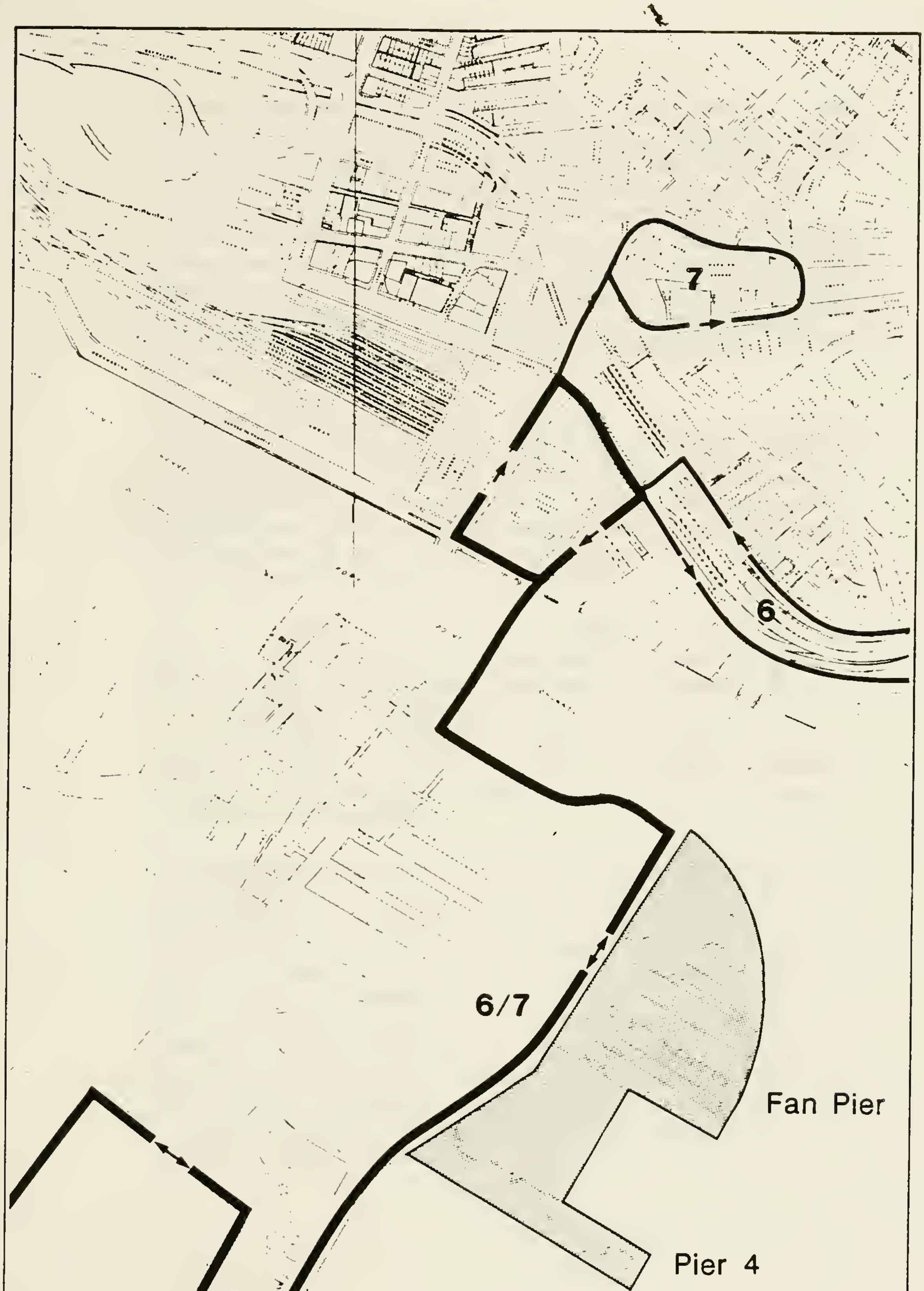
Line/Segment	Peak Station	Existing Ridership*	Line Capacity for Each Direction**
Red Line/North Ashmont-Alewife Braintree-Alewife	Charles	7,140	10,800
Red Line/South Alewife-Ashmont Alewife-Braintree Park-Quincy	Andrew	11,190	11,520
Green Line/West Cleveland Circle Boston College Riverside Huntington Avenue	Arlington	10,000	7,500
Green Line/North Lechmere Service	Science Park	1,100	2,600
Orange Line/North Forest Hills-Oak Grove	North Station	10,270	9,300
Orange Line/South Oak Grove-Forest Hills	Essex	7,080	9,300
Blue Line/North Bowdoin-Wonderland	Aquarium	6,120	6,600

---

* Red Line and Green Line/West ridership figures are based on independent observations in fall 1986; other ridership figures are based on 1984 MBTA counts.

** See preceding table.

FIGURE 6
Local MTBA
Bus Routes 6
and 7 in
Vicinity of
Projects



Route 6 operates only during weekday peak periods, with buses scheduled at 15-minute intervals. Service to and from Haymarket Station is provided only at half-hour intervals. Route 7 operates on weekdays between the hours of 5:15 AM and 10:15 PM. During peak hours, scheduled headways average 12 minutes in the morning and 14 minutes during the afternoon. Based on the published schedules for Routes 6 and 7, a total of nine buses per direction serve the site along Northern Avenue during the morning peak hour, while eight serve the sites during the evening peak hour.

The typical bus used on Routes 6 and 7 has a seating capacity of 46 passengers. Its normal carrying capacity is 60 passengers, although greater loads can be accommodated under crush conditions. Based on the scheduled headways and normal capacities, 660 passengers can be accommodated in each direction in the morning peak hour, while 540 can be handled in the evening.

Ridership information for early 1985 was provided by the MBTA for Routes 6 and 7. These data are summarized in Table 10, which shows peak passenger bus loads. The peak passenger load point information was collected at the intersection of Congress Street and Dorchester Avenue. On both routes, the heavier flows are outbound from South Station in the morning and inbound to South Station in the evening.

The busiest hour of the day for Route 6 is 7:00-8:00 AM, when outbound passengers total 199 or 83 percent of normal capacity. For Route 7, the morning peak hour is 8:00-9:00 AM, when 194 outbound passengers (65 percent of normal capacity) are carried. Because both routes serve industrial areas, peak loading in the evening occurs between 3:00 and 4:00 PM, when 69 percent of each route's normal inbound capacity is utilized. Between 4:00 and 5:00 PM, Route 6 and 7 inbound capacities are respectively 44 percent and 58 percent utilized; between 5:00 and 6:00 PM, utilization rates are, respectively, 36 percent and 17 percent.

TABLE 10
Local Bus
Capacity and
Ridership*

Direction/ Time Period	Route 6		Route 7		Total	
	Capacity	Passengers	Capacity	Passengers	Capacity	Passengers
Outbound from South Station						
6:00-7:00 AM	240	167	120	61	360	228
7:00-8:00 AM	240	199	300	169	540	368
8:00-9:00 AM	240	123	300	194	540	317
Total	720	489	720	424	1,440	913
Inbound to South Station						
3:00-4:00 PM	240	166	240	165	480	331
4:00-5:00 PM	240	106	240	138	480	244
5:00-6:00 PM	240	86	240	40	480	126
Total	720	358	720	343	1,440	701

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* Peak passenger loadings at Congress Street and Dorchester Avenue.

NOTE: Typical bus seating capacity is 46 passengers. Normal capacity (used for peak hour planning) is 60 passengers.

SOURCE: Massachusetts Bay Transportation Authority passenger counts for February 26, May 1 and May 17, 1985.

Commuter Express Bus Service

Five MBTA commuter express bus routes operate from the Downtown financial district to suburban communities west of Boston. The buses operate along the Massachusetts Turnpike and stop at the corner of Franklin and Federal Streets. This location, approximately 3,600 feet from the proposed Fan Pier offices and 4,600 feet from Pier 4, is linked to both sites by Bus Route 7. As shown in Table 11, 52 express buses are scheduled to arrive Downtown between 7:30 and 8:30 AM. In the evening, 46 buses are scheduled to depart between 4:30 and 5:30 PM. The MBTA uses the same planning capacity figure for express buses as for local buses, i.e., 60 passengers per bus. Therefore, the peak hour morning inbound capacity of the express buses is 3,120 and the peak hour evening outbound capacity is 2,760. Ridership during the PM peak hour is about 2,520 or 91 percent of capacity.

TABLE 11
Commuter Bus Service to Financial District

Route Number	Name	Number of Buses* AM Peak	PM Peak
300	Riverside	10	8
301	Brighton Center	10	9
304/304A	Newton Corner	14	14
305	Central Square Waltham	7	6
310**	Needham	11	9
Total	52	46	

* Arrivals between 7:30 and 8:30 AM and departures between 4:30 and 5:30 PM, as of fall, 1986.

** Arrivals and departures at Franklin and Devonshire Streets. This bus is to be phased out with the re-instatement of commuter rail service to Needham.

Several private operators, such as Plymouth and Brockton and Brush Hill lines, provide commuter bus service to South Station. These lines generally serve the South Shore. The MBTA provides commuter bus service from the north to Haymarket Station, while private bus operators, such as Hudson Bus Line, also provide service to the Haymarket area.

Commuter Rail

The MBTA's commuter rail trains operate from North Station and South Station. The system is comprised of eight branches, four of which terminate at South Station (Framingham, Franklin, Attleboro and Stoughton). The South Station terminal is within walking distance of the proposed project sites or can be reached via Bus Route 6 or 7. North Station can be reached by taking Route 6 or 7 to the Red Line and transferring at Washington to the Orange Line, or by taking Route 6 to Haymarket and walking one-quarter mile. Table 12 summarizes the capacity and ridership of the commuter rail service.

TABLE 12
Summary of Existing Commuter Rail Service

Branch	Number of Trains		Peak Period Seating Capacity*		Peak Period Ridership**	
	AM	PM	AM	PM	AM	PM
Framingham	4	4	2,300	1,700	2,210	1,815
Franklin	5	4	2,800	2,400	3,000	2,505
Attleboro	5	5	2,800	3,300	2,935	2,640
Stoughton	4	3	2,200	1,500	2,070	1,170
Rockport/ Ipswich	6	6	2,300	2,300	2,530	2,140
Haverhill/ Reading	6	5	2,400	2,000	1,825	1,440
Lowell	6	6	1,700	1,600	1,100	1,140
Gardner/ Fitchburg	4	4	1,300	1,200	1,230	1,045

* Seating capacity is based on 100 seats per car.
** Represents winter 1984 data.

SOURCE: MBTA Commuter Rail Section.

As can be seen from the table, overall peak period ridership on the commuter rail system generally does not exceed the seating capacity. However, there are instances where standees exist on various train trips. When the number of standees on a particular train regularly approximates 50, consideration is given to adding a car, if feasible.

Commuter Boat

An increasingly important part of the public transportation system serving Downtown Boston is the commuter boat service. Although it carries fewer passengers than other forms of transportation, there has been increased emphasis on improving the service and ridership has been building dramatically.

Commuter boat service to Downtown is provided from Hull (50 minutes), Hingham (30 minutes), and Quincy (25 minutes). A total of 11 boat trips operate during morning and evening peak commuter periods and can accommodate almost 1,600 passengers. All vessels have full weather protection. Hingham and Quincy trips dock at Rowes Wharf; the Hull boat docks at Long Wharf. Specific capacity and ridership information is provided in Table 13.

TABLE 13
Peak Period*
Commuter
Boat Service

From	To	Trips	Capacity	Ridership
Hingham	Rowes Wharf	8	1,019	575
Hull	Long Wharf	1	300	100-200**
Quincy	Rowes Wharf	2	278	50-65
		11	1,597	725-840

* 6:00 AM - 9:30 AM and 3:15 PM - 7:30 PM.
** Highly seasonal

The commuter boat dock at Rowes Wharf is located within walking distance of the Fan Pier and Pier 4 Projects and, with the exception of local bus service, is the closest of all the public transportation facilities serving the sites. An improved docking facility will be incorporated within the Rowes Wharf Development which is currently under construction. With the increased emphasis being placed on this mode at the state level, there is potential for a significant increase in usage.

EXISTING PARKING

The Fan Pier site currently serves as a surface parking lot used by daily commuters working in Downtown Boston. This lot has proved to be attractive to Downtown workers because, at $3.50 per day, it is considerably less expensive than Downtown parking. The practical capacity of the lot is approximately 2,000 vehicles. In June and

July of 1985, daily usage averaged approximately 1,125 vehicles. This is down almost 25 percent from a daily average of 1,470 in June and July of 1984 when the fee was only $2.00 per day. Peak hour counts taken in June 1985 indicate that almost 510 vehicles entered the lot in the morning peak hour. In the evening peak hour, almost 440 vehicles exited from the lot.

Table 14 shows the directional distribution of the peak hour entering and exiting vehicles. The majority of the commuters access the surface lot from Atlantic Avenue.

TABLE 14
Directional Distribution of Fan Pier Parkers

	AM	PM
Location	Entering Vehicles Percent From	Exiting Vehicles Percent To
Atlantic Avenue-West	73	70
Sleeper Street-South	7	5
Ramp Street-East	20	25

In addition to using the Fan Pier lot, daily commuters also park on the "Cabot, Cabot & Forbes" parcel on the south side of Northern Avenue. On-street parking is available along Northern Avenue and is used extensively by tour buses, especially those associated with the Children's Museum. Finally, about 650 spaces are located on Pier 4. These spaces are restricted to use by patrons of Anthony's Pier 4 Restaurant.

ASSUMED FUTURE TRANSPORTATION SYSTEM

Several changes to the area's transportation system are expected to be constructed or implemented by the 1995 analysis year. The changes listed below will affect travel to and from the project sites and have been included in the No-Build and Build analyses.

PLANNED ROADWAY IMPROVEMENTS

- Relocated Northern Avenue Bridge and New Northern Avenue - The existing Northern Avenue Bridge across the Fort Point Channel will be replaced with a new structure several hundred feet south of the existing structure. A new Northern Avenue will be built between the new span and B Street, parallel to the existing Northern Avenue. Figure 7 shows the proposed bridge and street location. Construction

IGURE 7
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New)
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 Seaport
cess Road

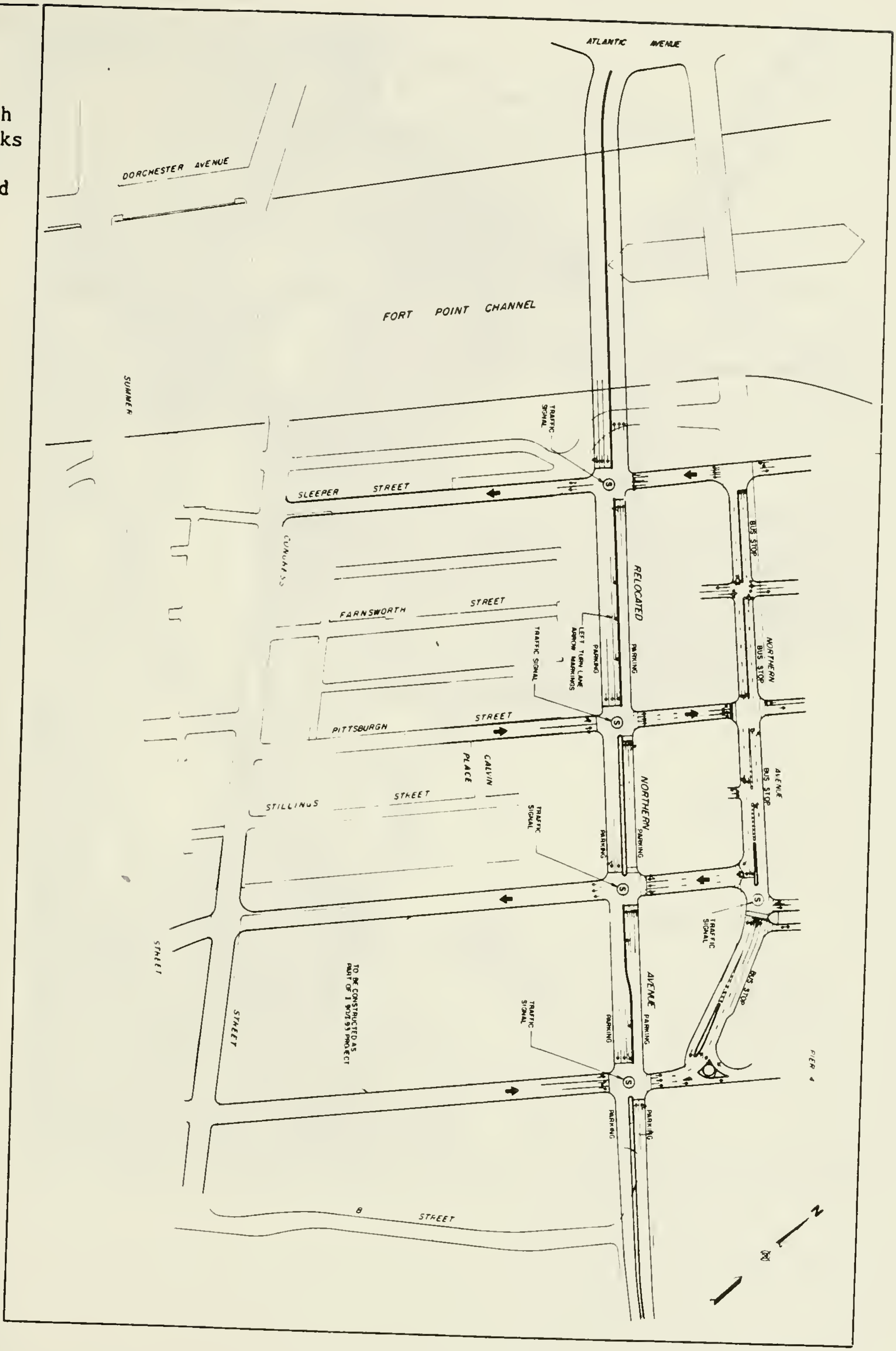
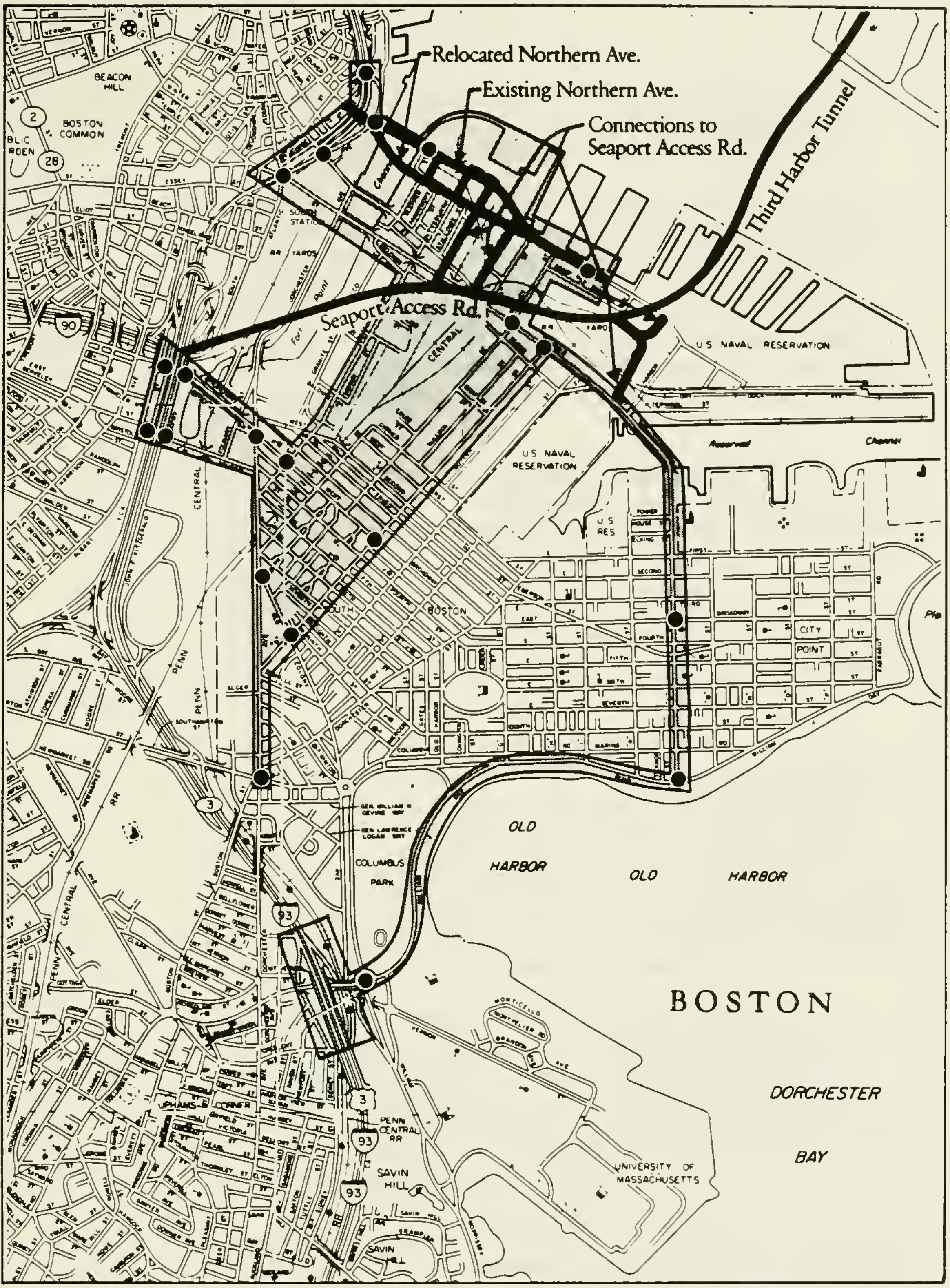


FIGURE 8
Future
Network With
Seaport
Access Road/
Third Harbor
Tunnel Portions of
I-90/I-93
Project



is expected to begin in 1987 and be completed by 1990. This project is the responsibility of the Massachusetts Department of Public Works (MDPW).

- Local Grid Street System - Connections between the old and new Northern Avenue are planned at Sleeper Street, Pittsburg Street, Pier 4, and a location between Pittsburg Street and Pier 4, as shown in Figure 7. Included in this project is the reconstruction of the existing Northern Avenue. Design work is expected to be completed by 1988. The MDPW will have responsibility for construction which will be completed by 1990.

- Congress Street and Summer Street Bridge Rehabilitation - The bridges across the Fort Point Channel will be repaired to eliminate current weight restrictions which restrict their full utilization by heavy vehicles. The design of both bridges is currently underway and is the responsibility of the City of Boston. Construction will be the responsibility of the MDPW and is expected to be completed by March of 1990.

- North Area/Central Artery Project - The existing Central Artery Bridge over the Charles River and its connections to I-93, Route 1 and the Tobin Bridge will be reconstructed to relieve a severe safety problem and capacity bottleneck. A multi-level, fully-directional interchange will be provided. The Massachusetts Departments of Public Works indicates that construction is scheduled to being in mid-1987 and should take three years to complete.

- Day Boulevard Improvements - The Metropolitan District Commission (MDC), which has jurisdiction over Day Boulevard, has plans to install traffic signals at several locations along the Boulevard. Only one of these signals will be located west of L Street (at Columbus Park) along the section of roadway used by daily commuters.

- Third Harbor Tunnel and Seaport Access Road - This project involves construction of a new Third Harbor Tunnel under Boston harbor to Logan Airport and the regional highway system north of the Airport, and construction of a connecting roadway, called the Seaport Access Road, through South Boston between the current terminus of the Massachusetts Turnpike at I-93 and the new Third Harbor Tunnel. The Seaport Access Roadway will have ramp connections to the South Boston street network. Figure 8 shows the future South Boston street network with the proposed

Seaport Access Road and Third Harbor Tunnel. This project is part of the larger I-90/I-93 project, which also includes the Depression of the Central Artery. The I-90/I-93 project is currently under design by the Central Artery Team. The current construction schedule calls for the completion of the Seaport Access Road and Third Harbor Tunnel in 1994. The northbound Central Artery is expected to be open in 1995 and the southbound Artery in 1996. Completion of all ramp connections to the Central Artery and removal of the existing structure are expected in 1998.

The 1995 transportation analysis for the Fan Pier and Pier 4 developments assumed the completion of the Seaport Access Road and Third Harbor Tunnel. The depression of the Central Artery was not included and, therefore, the existing ramp connections and Artery configuration were included in the roadway network.

PLANNED PUBLIC TRANSPORTATION IMPROVEMENTS

The most significant public transportation improvements planned which will affect service to the proposed projects are the development of the Transportation Center at South Station and the upgrading of service on the Red, Orange and Green Lines. The rehabilitation and expansion of South Station, which are currently underway, will result in a centralized location for many transportation services. Included will be Amtrak; MBTA Commuter Rail; commuter and intercity bus service; direct connections within the Station area to the Red Line; parking for 500 cars initially, with planned expansion to 2,000 spaces; and direct ramp connections to the South Bay interchange serving the Southeast Expressway, the Massachusetts Turnpike Extension, the Central Artery and, ultimately, the Seaport Access Road and Third Harbor Tunnel. The result will be a major intermodal transportation center located within walking distance of the sites and connected to them by two local MBTA bus routes (Routes 6 and 7).

The MBTA is making major capacity and reliability improvements to the Orange, Red, and Green Lines. These improvements include the following:

- The Southwest Corridor Project - This project, which is nearing completion, involves the expansion of Orange Line trains from four to six cars and the relocation of the southern portion of the line to a

new right-of-way. The segment involved is approximately 4.7 miles in length and includes eight new stations. This project is scheduled for opening in early 1987.

- Station Expansion - Three older Orange Line Stations and seven Red Line stations, including South Station, will be modernized and expanded. When the work is completed in 1988, the Red and Orange Lines will accommodate six-car trains instead of the current maximum of four cars. As a result, a 50 percent increase in capacity is possible if current schedules are maintained. In fact, the MBTA is planning 50 percent and 33 percent increases in scheduled capacity on the Red and Orange Lines, respectively.

- Power System Upgrade - The Green Line power system will be enhanced to propel three-car trains instead of the current two-car maximum.

- Acquisition of New Cars - Between 1986 and 1989, the MBTA will put 58 new Red Line cars and 100 new Green Line cars into service.

- Renovation of Existing Cars -- The renovation of all 76 Silverbird cars in the Red Line fleet is now underway. Renovation should be completed and all cars returned to service by 1989. The Red Line's 88-car Bluebird fleet was recently rebuilt so that by 1989 the entire Red Line fleet will be newly renovated or newly acquired.

- Track Reconstruction -- In May 1985, a construction project to replace the entire Red Line track structure from Harvard Station to Charles Street was begun. This project should be complete in 1987, when the next phase of reconstruction between Charles Street and Andrew Station will begin. Extensive Green Line track work was completed in 1986.

All these projects are forecast to be completed well in advance of the 1995 Build year for the Fan Pier and Pier 4 Projects. As a result of these improvements, the Red, Orange, and Green Lines will have increased capacity and greater reliability.

PROBABLE PROJECT IMPACTS

In order to assess the probable impacts of the proposed Fan Pier and Pier 4 Developments on the area's transportation system, it is necessary to project travel demands from the proposed projects as well as from other likely 1995 developments in the area. The new demands must be added to existing base conditions in order to derive a projection of future conditions.

TRAVEL DEMANDS

Trip Generation

To assess the impact of the proposed Fan Pier and Pier 4 Developments, separate travel demand estimates by land use and type of trip (work and non-work) were made. This approach uses daily person-trip generation rates for office, retail, and hotel uses for both trip types. Mode split factors, peak hour factors, and vehicle occupancy rates were then applied to the daily person-trip rates to obtain peak hour vehicle-trip and transit-trip generation rates. The assumptions for office, retail, and hotel were developed from multiple sources, including the Boston CBD Parking Study; recent EIRs prepared for major projects in Downtown Boston; 1980 Journey-to-Work Census data for South Boston; and surveys of the Marriott Long Wharf Hotel and the Holiday Inn on Cambridge Street in Boston. Residential trip generation rates were obtained from a survey of Harbor Towers, a Downtown waterfront residential development. The Appendix provides a detailed listing of vehicle-trip and transit-trip generation rates and an explanation of the trip generation assumptions used to project Fan Pier and Pier 4 travel demands.

The analysis of travel behavior patterns, and in particular the choice of mode, was carried out with an understanding that 1995 conditions in South Boston will be conducive to transit serving as the primary means of travel to and from work. This applies to the Fan Pier and Pier 4 Projects as well as nearby background development in South Boston. These conditions include: an urban environment and development density that is related to that of Downtown Boston today; the projects proximity to Downtown which, in effect, makes the project area an extension of Downtown Boston; a parking supply that is limited and a daily parking cost that will be expensive and equivalent to Downtown rates; and most important of all, an extensive public transit network. This network consists of: direct express bus service to suburban locations and frequent shuttle bus service to South Station, both operating on exclusive high-occupancy vehicle (HOV) lanes on the Seaport Access

Road; frequent shuttle bus service to MBTA transit facilities in Downtown Boston; and water transportation routes providing direct links to such locations as Long Wharf, North Station, Logan Airport, and the South Shore. All of these services are expected to be in operation by 1995. Beyond that time frame, as additional development occurs, it is expected that transit service operating on exclusive rights-of-way will be constructed to provide high speed direct access to the MBTA regional system.

The proposed projects are mixed-use developments consisting of office, retail, hotel, and residential uses. The proposed development programs were shown earlier in Table 1. Travel demand characteristics detailed in the Appendix were applied to these program elements to calculate vehicle-trip and transit-trip demands, which are shown in Table 15.

TABLE 15
1995 Project Travel Demands

	Vehicle-Trips			Person Trips on Transit		
Time	Fan Pier	Pier 4	Total	Fan Pier	Pier 4	Total
Daily						
In	5,317	2,930	8,247	8,530	3,330	11,860
Out	5,317	2,930	8 247	8,530	3,330	11,860
Total	10,634	5,860	16,494	17,060	6,660	23,720
AM Peak Hour						
In	857	442	1,299	2,444	950	3,394
Out	265	142	407	261	156	417
Total	1,122	584	1,706	2,705	1,106	3,811
PM Peak Hour						
In	383	197	580	417	214	631
Out	974	518	1,492	2,598	1,015	3,613
Total	1,357	715	2,072	3,015	1,229	4,244

NOTE: Vehicle-trip volumes include delivery vehicles and taxis as well as private automobiles. Transit-trip volumes include rapid transit, commuter bus, commuter rail and commuter boat trips.

The proposed developments would generate approximately 16,500 vehicle-trips daily and 23,700 transit-trips daily. During the morning peak hour, vehicular volume is expected to be 1,700, or 10.3 percent of the daily total. The evening peak hour vehicle volume is projected to be approximately 2,070, or 12.6 percent of the daily total. For public transportation, the morning

peak hour volume is projected to be 3,810 person-trips, or 16.1 percent of the daily total, while the evening volume would be approximately 4,240, or 17.9 percent of the daily transit total.

In the morning peak hour, approximately 76 percent of the projected vehicle-trips are expected to be inbound toward the project sites, while in the evening, approximately 72 percent of the trips will be outbound leaving the project sites. For public transportation, 89 percent of the morning trips and 85 percent of the evening trips will be in the peak direction.

Table 16 shows the breakdown of daily, morning peak hour and evening peak hour person trips by mode. On a daily basis, 43 percent of project trips are expected to be made by transit, 47 percent by automobile and 10 percent by walking. In the peak hours, the transit use percentages are projected to be higher than for daily conditions, while automobile and walk percentages will be lower. In the morning peak hour the transit percentage is expected to be 55 percent while in the evening peak hour it is expected to be 52 percent. Automobile trips will account for 41 percent and 42 percent, respectively, of morning and evening peak hour trips.

TABLE 16
1995 Person Trips
By Mode

Time/Project	Auto	Transit	Walk	Total
Daily				
Fan Pier	16,617	17,060	3,594	37,271
Pier 4	9,184	6,660	1,698	17,542
Total	25,801	23,720	5,292	54,813
Percent	47%	43%	10%	100%
AM Peak Hour				
Fan Pier	1,853	2,705	190	4,748
Pier 4	963	1,106	91	2,160
Total	2,816	3,811	281	6,908
Percent	41%	55%	4%	100%
PM Peak Hour				
Fan Pier	2,219	3,015	323	5,557
Pier 4	1,169	1,229	154	2,552
Total	3,388	4,244	477	8,109
Percent	42%	52%	6%	100%

Net Additional Peak Hour Vehicle Trips

The Fan Pier is currently used for long-term (all day) parking for daily commuters to Downtown Boston. This parking will be eliminated under the proposed development plan and, as discussed in the Parking Impacts section, no new comparably-priced alternative parking for these commuters is likely to be available with assumed 1995 developments in place. As a result, traffic associated with this activity will be removed from area roadways with the development of the Fan Pier.

In order to determine the net impact of the proposed developments, the traffic volumes associated with the existing use have been subtracted from the future Build volumes. A similar procedure was utilized in determining background traffic generated by the CC&F development parcel that is currently used for parking south of Northern Avenue. However, to be conservative, this was done only for intersections close to the project sites where the existing volumes are large enough to potentially affect the level of service analysis. As a result, Build volumes for intersections south of East and West Broadway are generally somewhat overstated because the existing parking traffic was not removed.

Delivery Vehicle and Taxi Trips

A certain amount of the total daily vehicle generation described above will consist of taxi and delivery vehicle trips. Delivery vehicles are typically single-unit, two-axle vans, not large semi-trucks. Table 17 summarizes the expected delivery vehicle traffic for the office, retail and hotel uses. Only minor amounts of delivery vehicle traffic would be associated with residential uses. Due to the proximity of the Fan Pier and Pier 4 Projects, the delivery vehicle rate was applied only to Fan Pier since it is likely multiple stops will be made by delivery vehicles.

TABLE 17
Daily Delivery Vehicle Arrivals

	Office	Retail	Hotel	Total
Generation Rates	0.21 arrivals/ 1,000 sq. ft.*	0.24 arrivals/ 1,000 sq. ft.*	0.13 arrivals/ room**	
	278	37	105	420

* Based on Copley Place EIR.

** Based on counts taken at the Marriott Long Wharf Hotel in May, 1985.

At 1995 Full Build, approximately 420 deliveries are expected daily at the proposed developments. The complex would average almost 47 delivery vehicles per hour assuming a constant distribution over a nine-hour day. This is conservatively high in that some deliveries will most likely occur at night. If it is further assumed that each delivery vehicle arrives and departs within the same hour, then a maximum of approximately 94 delivery-vehicle trips per hour would occur. This volume constitutes 5.5 percent of the total morning peak hour traffic volume and 4.5 percent of the evening peak hour traffic volume generated by both projects. By comparison, truck traffic currently comprises 18 percent of morning peak hour volumes along Northern Avenue.

As currently planned, service entrances to all structures except two will be provided via the Projects' internal street system and underground garages. The only exceptions would be Fan Pier Parcel A which would have a service entrance on Old Northern Avenue at the Seaport Access Road entrance and a Pier 4 truck entrance on Northern Avenue adjacent to the property line between Pier 4 and Fan Pier.

Total taxi traffic is summarized in Table 18. At Full Build, approximately 620 taxi arrivals per day are expected with more than one-half projected for the hotels and the remainder divided between office and retail uses. The entrances to the hotels will provide areas for picking up and discharging passengers, and taxi holding areas will be provided near the major office buildings. As an example, the Pier 4 entry court will have a long multi-purpose taxi holding area along its easternmost drive.

TABLE 18
Daily Taxi
Arrivals

	Office	Retail	Hotel	Total
Generation Rates	0.75 arrivals/ 100 person-trips*	0.75 arrivals/ 100 person-trips*	0.325 arrivals/ room**	
1995 Full Build				
Fan Pier	134	45	262	441
Pier 4	58	23	94	175
Total	192	68	356	616

* Based on Highway Research Board, NCHRP Report No. 62, Urban Travel Patterns for Hospitals, Universities, Office Buildings and Capitols, 1969.

** Based on counts taken at the Marriott Long Wharf Hotel in May, 1985.

BACKGROUND TRAFFIC GROWTH

Areawide traffic growth is a function of other new development in the area. This growth can be projected by the application of a generalized growth factor or by the assessment of specific development proposals. For this analysis, a combination of both approaches was used. Although information was available about possible new development in both South Boston and Downtown Boston, the Downtown information was limited primarily to development expected through 1990. In order to account for Downtown development through 1995, the analysis year for Full-Build of the projects, an additional five percent growth in Downtown background volumes was added. This factor was based on the growth in person-trips between 1972 and 1982 reported in the 1982 Cordon Count for Downtown Boston (see Appendix for more detail).

The anticipated traffic from each background development in South Boston and Downtown was added to the base network volumes to determine the No-Build conditions. Completed traffic studies were available for many of the Downtown projects and provided detailed information on projected AM and PM peak hour volumes. In cases where such volumes were not available for Downtown developments, trip generation equations based upon sources documented in the Appendix were used to calculate background development traffic based on the proposed use and size of each development. For South Boston developments near the sites, Fan Pier and Pier 4 rates were used because these developments, like the Fan Pier and Pier 4, are expected to represent an expansion of the Downtown into South Boston. Fan Pier and Pier 4 rates were used for the Cabot, Cabot & Forbes parcels, Commonwealth Flats, Pier 6, and Commonwealth Pier. For industrial uses, rates from the Institute of Transportation Engineer's (ITE) publication Trip Generation were modified and used. The ITE industrial vehicle-trip rates were reduced to reflect the higher transit usage and vehicle occupancy rates expected in both South Boston and Downtown. The Appendix provides a listing of the expected daily and peak hour volumes for each background development.

TRIP DISTRIBUTION

Generated vehicle-trips from the Fan Pier and Pier 4 Projects and other background development were distributed over the projected roadway system. This distribution was based on data available from a license plate survey of vehicles parked on the Fan Pier and

Cabot, Cabot & Forbes parcels provided by the Central Transportation Planning Staff (CTPS). The survey was conducted in early 1985. Table 19 illustrates the directional distribution used. The distribution was compared with the distribution used for the International Place EIR and the distribution based on the 1982 Cordon Count to verify the appropriateness of its use. The Appendix provides more detailed information on the development of the project trip distribution and shows a comparison of the distribution used with the 1982 Cordon Count and International Place EIR distributions.

TABLE 19
Trip Distribution by Major Route

Major Route	Percent
Route 1 (Tobin Bridge)	11
Interstate 93 (North)	14
Route 3 (North)	6
Route 2	8
Massachusetts Turnpike (I-90)	15
Boston Street/Dorchester Avenue	2
Southeast Expressway/ Morrissey Boulevard	44
Total	100

SOURCE: CTPS license plate survey of cars parked on Fan Pier and CC&F parcels.

In addition to determining the distribution of traffic to major routes in and out of the City, consideration was also given to alternative local routings between these major highways and the sites. Of particular concern were the local South Boston streets which would be used by Southeast Expressway and Massachusetts Turnpike traffic.

Traffic from these highways can reach the site today via several routes through South Boston as well as from Downtown across the Fort Point Channel bridges. The various routes through South Boston include L Street/Day Boulevard; D Street/Old Colony Avenue; A Street/ Dorchester Avenue/Old Colony Avenue; and A Street/West Broadway. Westbound and southbound traffic was assigned to these routes and to the relocated Northern Avenue,

Summer Street and Congress Street bridges across the Fort Point Channel (without mitigation measures which, in the future, tend to divert traffic off certain routes) based on a comparison of average peak hour travel times along these routes between the developments and the various access points to the Turnpike and the Expressway.

One final consideration with regard to assignment of trips to the network was the implementation schedule for the proposed Third Harbor Tunnel and Seaport Access Road. Current plans for the I-90/I-93 project include the full operation of the Third Harbor Tunnel and Seaport Access Road by 1994. The full operation of the Depressed Central Artery is not expected until 1998. Therefore, the distribution of Full Build development trips on area highways was based on a roadway network with the Third Harbor Tunnel and Seaport Access Road but without the Depressed Central Artery. The 1995 No-Build and Build conditions with the Third Harbor Tunnel and Seaport Access Road are shown in Figures 9 through 12.

ROADWAY IMPACTS

Introduction

The analysis of roadway impacts was conducted for 1995 Full Build with the Third Harbor Tunnel/Seaport Access Road portion of the I-90/I-93 project. The 1995 analysis scenario was based on Alternative 5A Modified of the Central Artery/Third Harbor Tunnel EIS. It includes the Harbor Tunnel itself and the Seaport Access Road through South Boston, but does not include the Depressed Central Artery through Downtown Boston. The depression of the Central Artery is strongly supported by the project developers and will be beneficial to the projects. However, it is not scheduled for full operation by the 1995 Build year for the Fan Pier and Pier 4 Projects. It should be noted that traffic impacts along the Seaport Access Road itself are not included, although its important junction points with the local road network in the project area are included.

Evening Peak Hour Volumes

Both the morning and evening peak hours were analyzed. However, throughout the Boston area, evening peak hour traffic volumes are generally the highest experienced during the day. Similarly, the highest volumes generated by Pier 4 and Fan Pier Developments would occur in the evening peak hour. To illustrate the impact of Fan Pier and Pier 4 traffic, Table 20 shows

FIGURE 9a
1995 AM
No-Build
Volumes

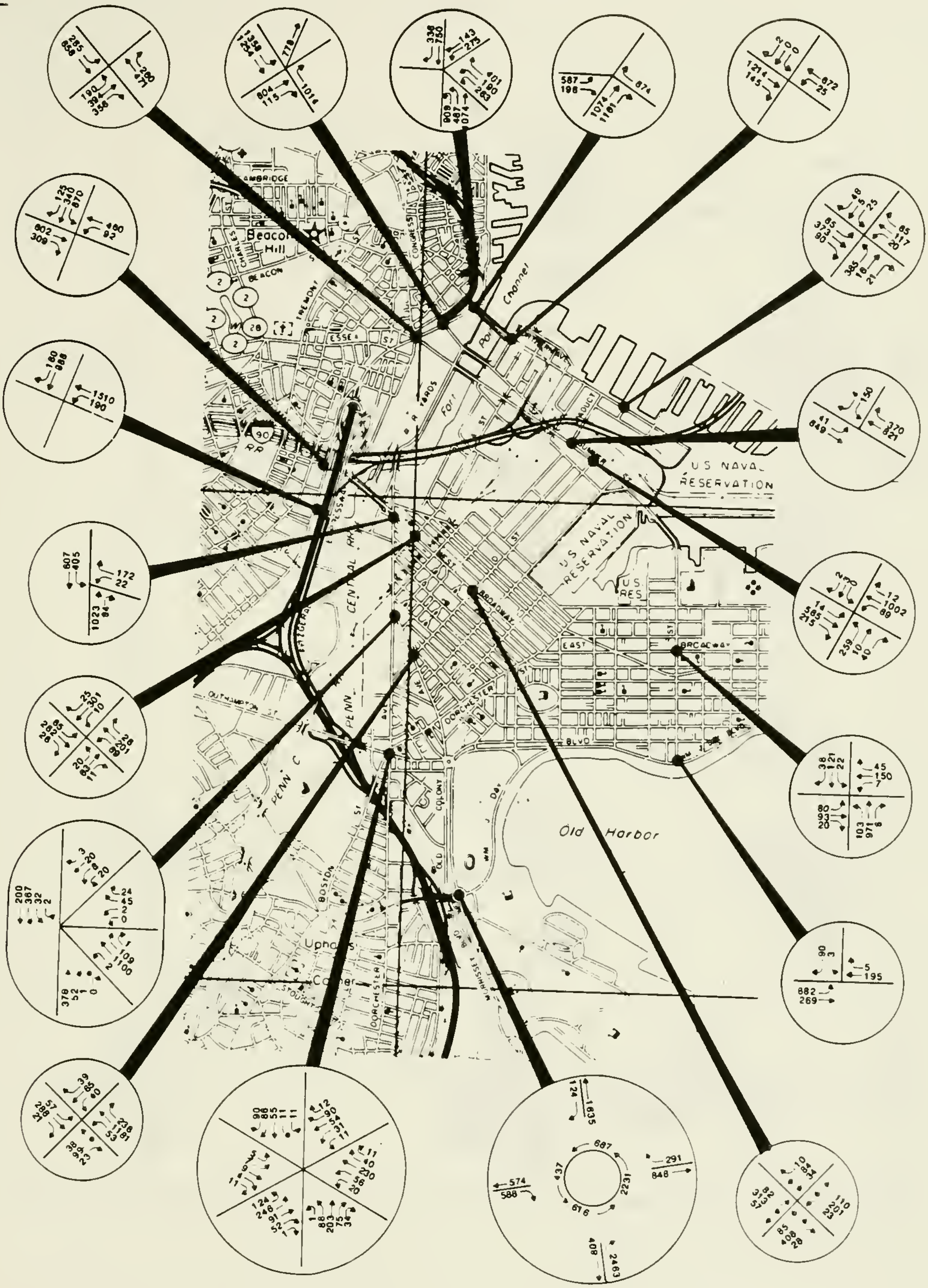


FIGURE 9b
1995 AM
No-Build
Volumes

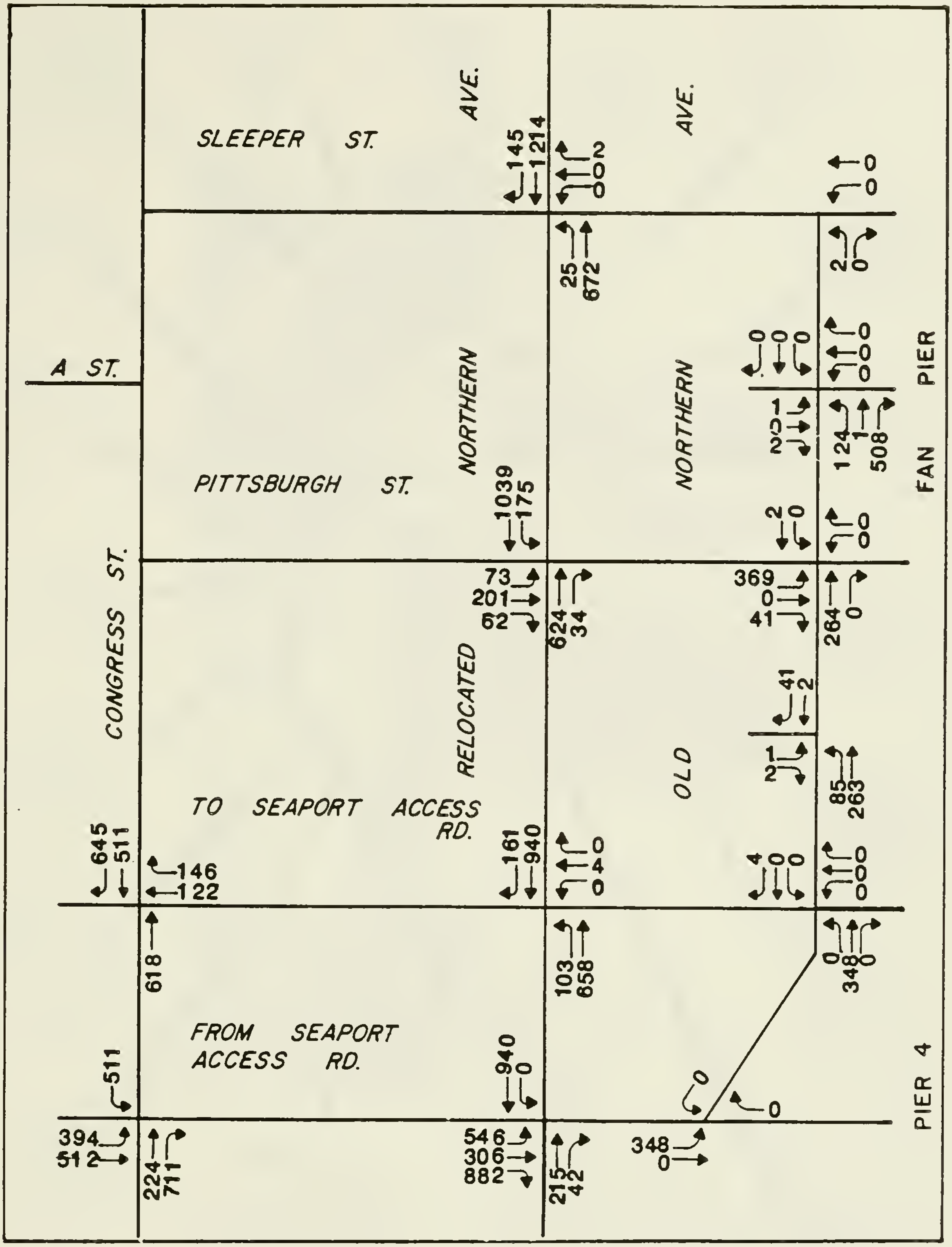


FIGURE 10a
1995 PM
No-Build
Volumes

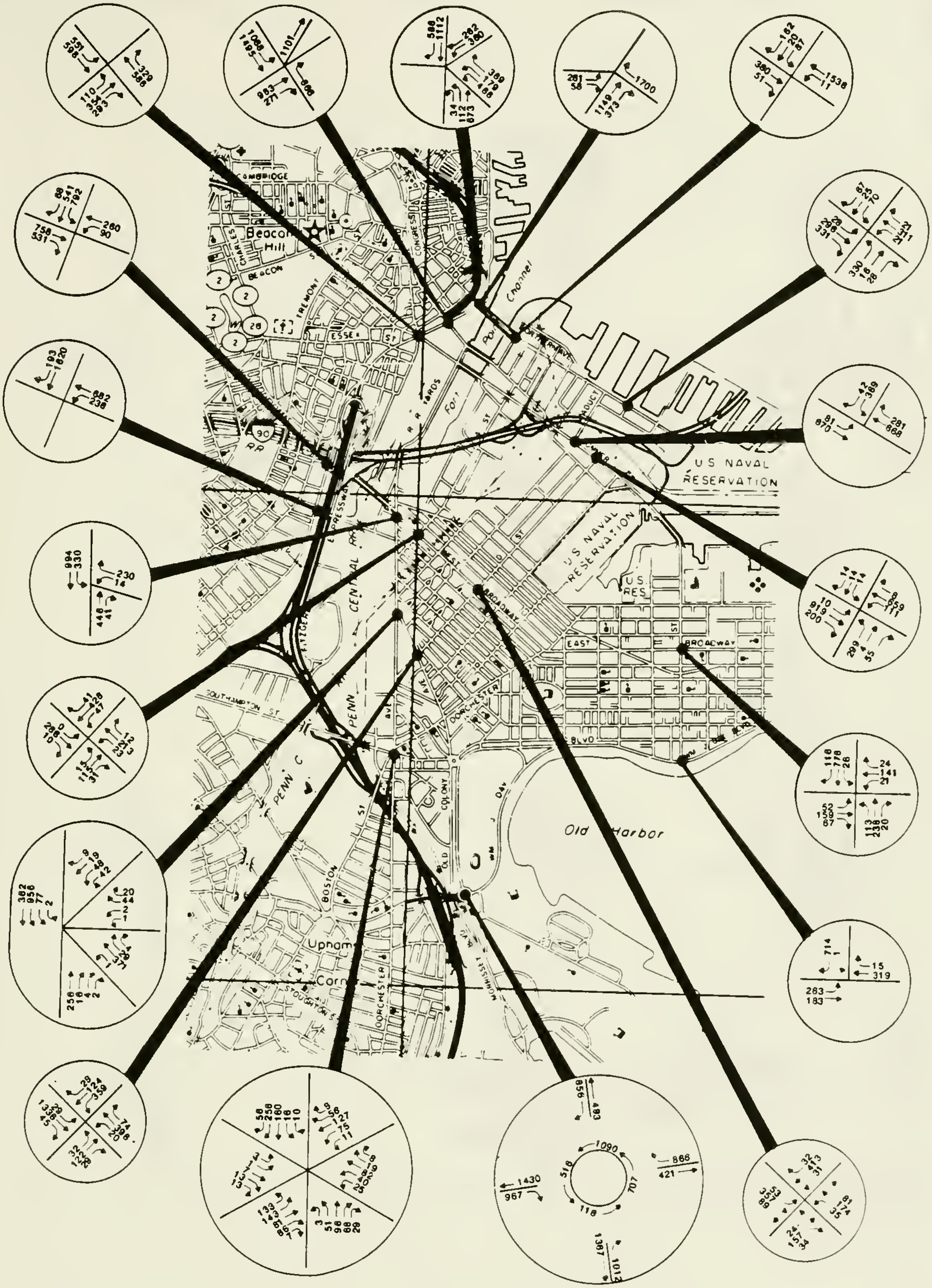


FIGURE 10b
1995 PM
No-Build
Volumes

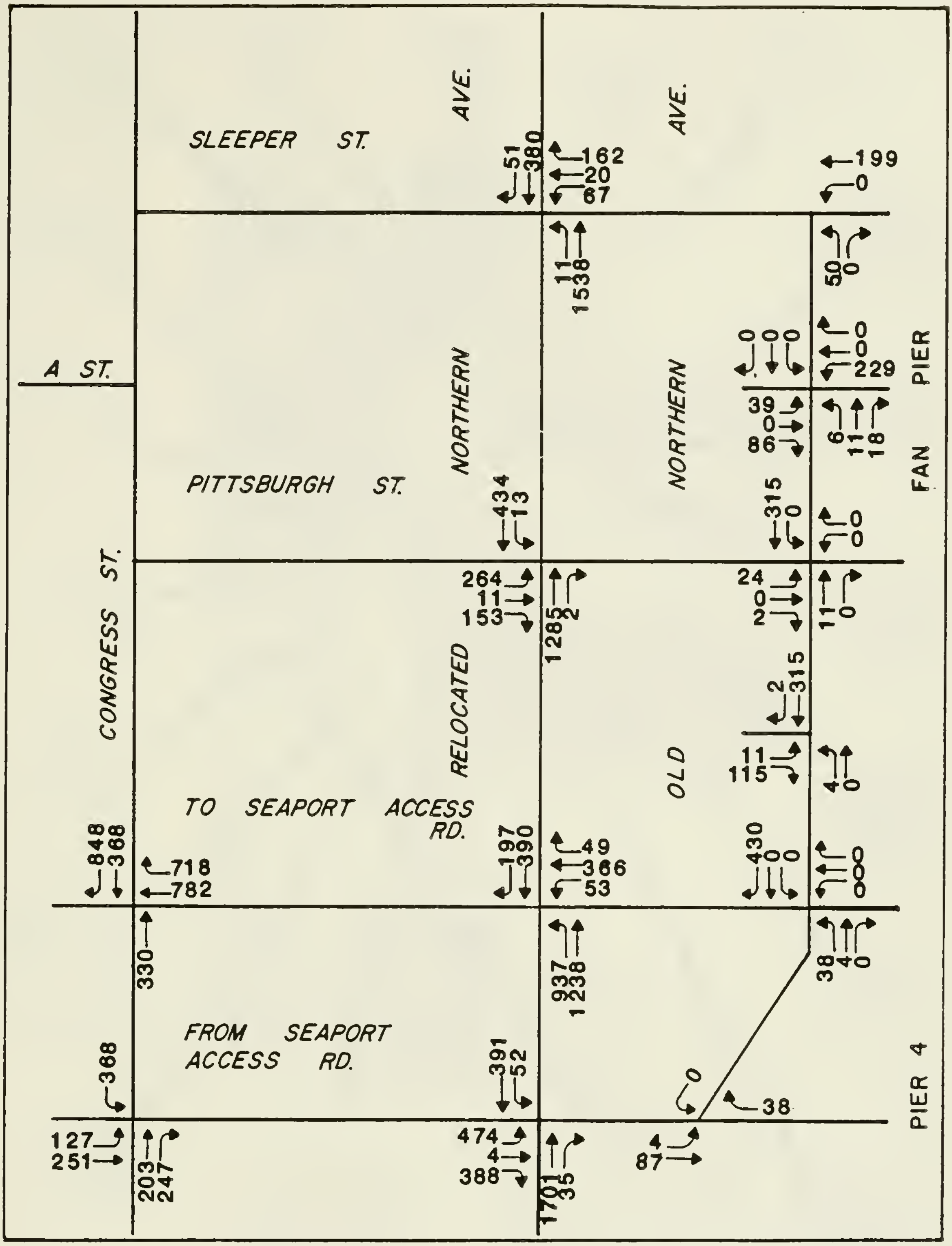


FIGURE 11a
1995 AM
Build
Volumes

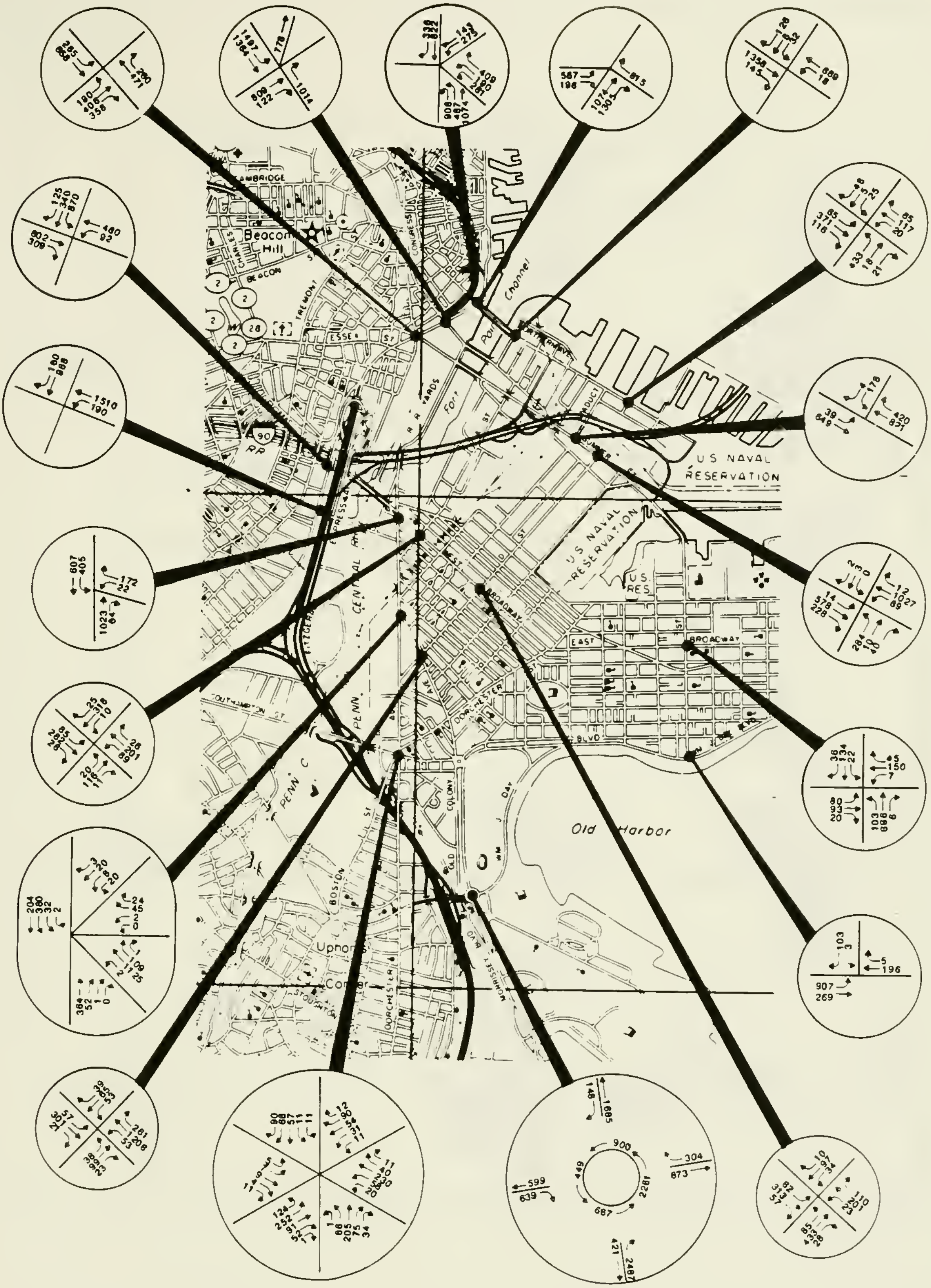


FIGURE 11b
1995 AM
Build
Volumes

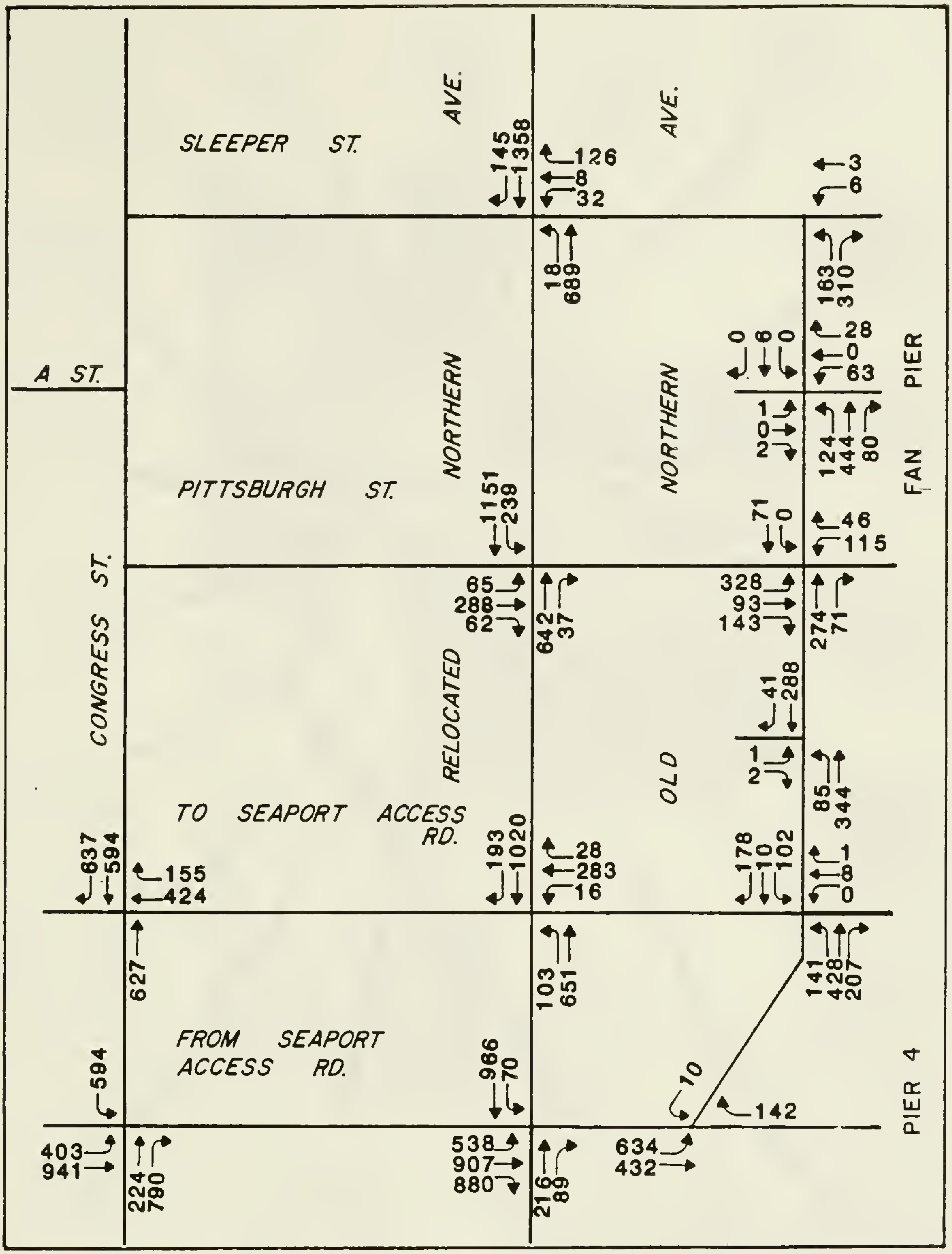


FIGURE 12a
1995 PM
Build
Volumes

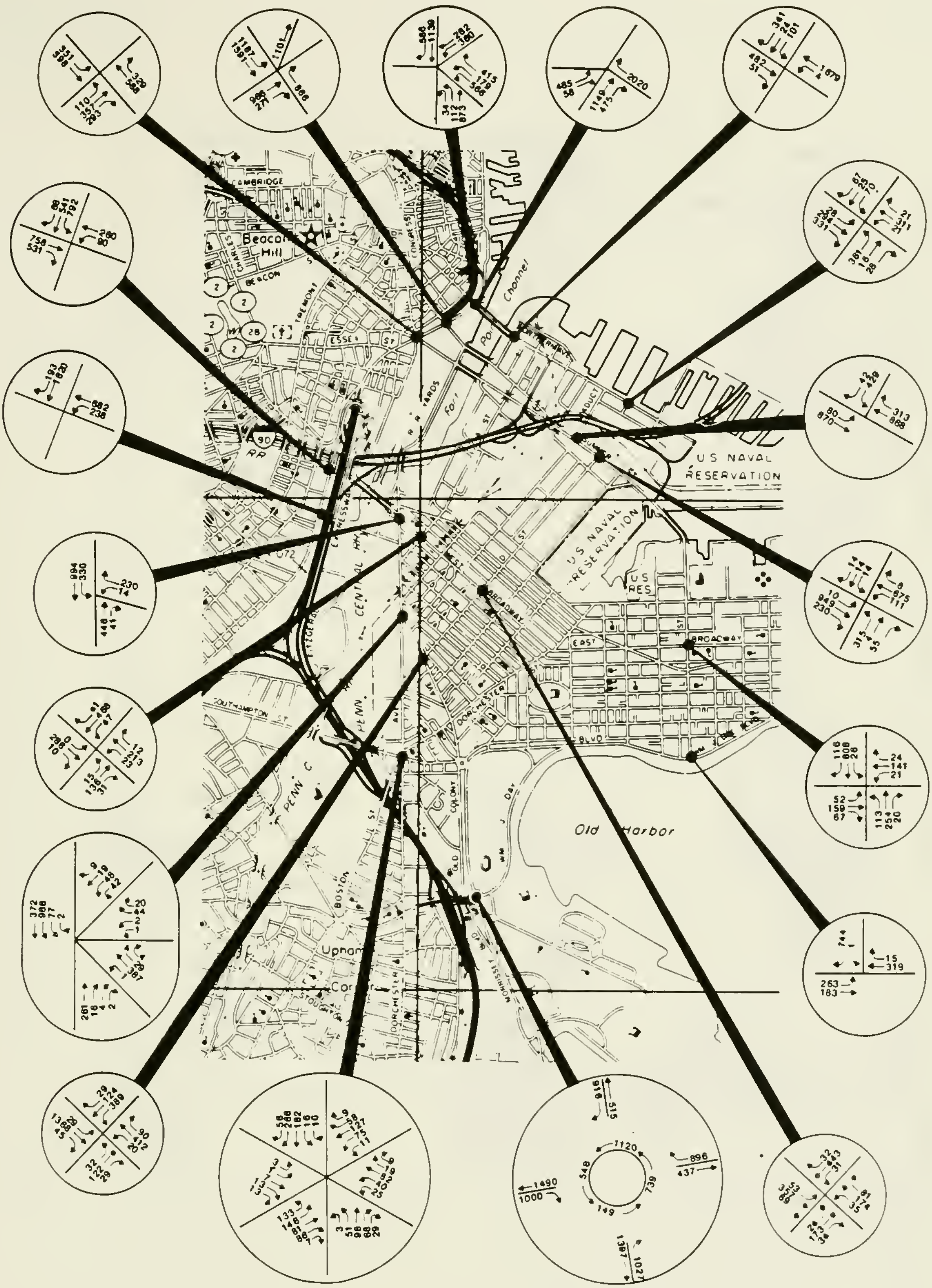
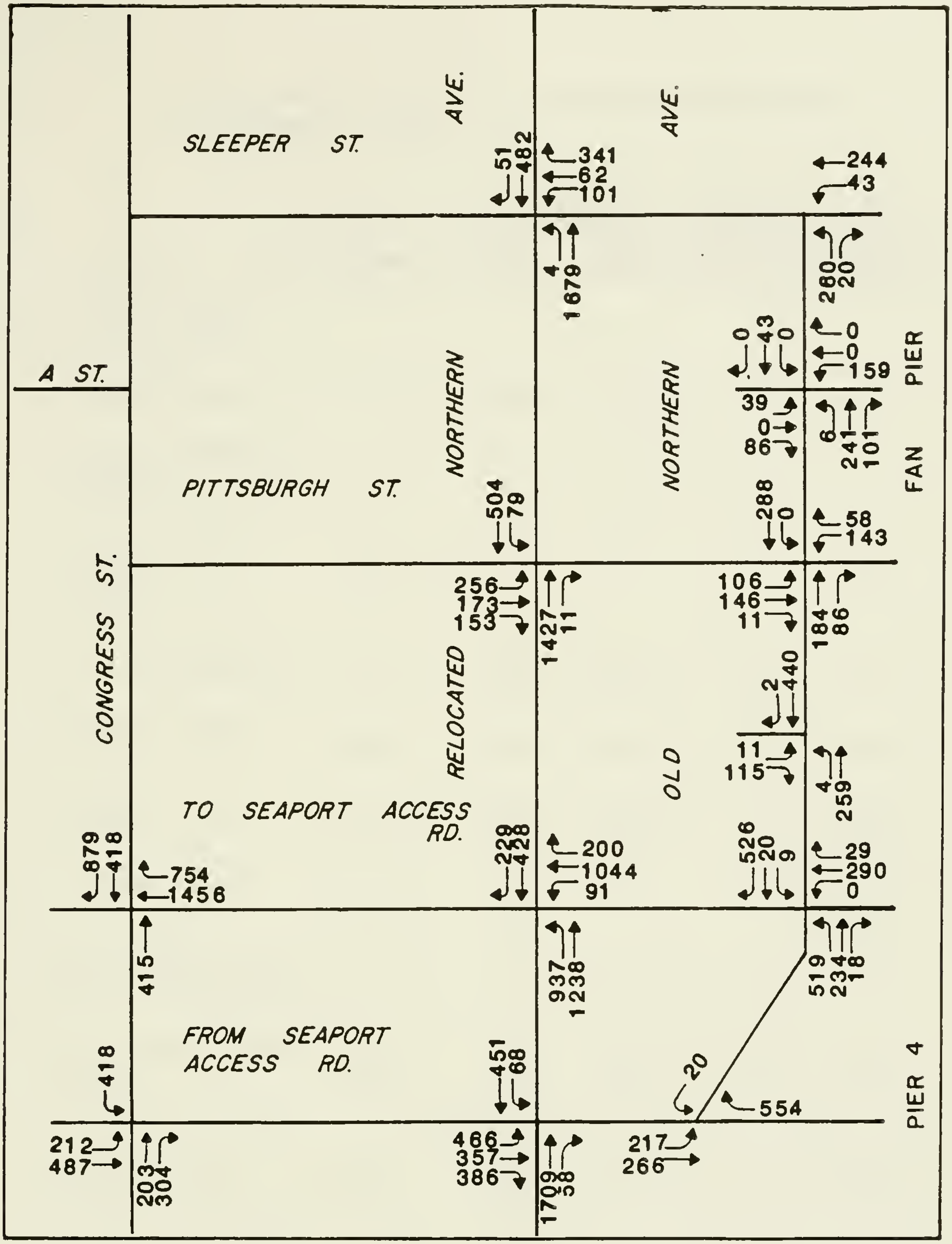


FIGURE 12b
1995 PM
Build
Volumes



evening peak hour traffic increases on selected study area roadways in 1995.

TABLE 20
1995 PM Peak Hour Roadway Increases With Seaport Access Road and Third Harbor Tunnel Project

Corridor	Existing Volume	1995 No-Build Volume	1995 Build Volume	Increase from No-Build to Build Amount	Increase from No-Build to Build Percent
Seaport Access Road Entrance south of Congress Street	N/A	1,630	2,335	705	43.3
Atlantic Avenue north of Northern Avenue	2,271	3,130	3,450	320	10.2
Northern Avenue Bridge	1,731	2,131	2,553	422	19.8
Northern Avenue west of Ramp Street	918	1,363	1,454	91	6.7
Congress Street Bridge	1,816	2,432	2,528	96	3.9
Summer Street Bridge	1,326	1,808	1,808	0	0.0
A Street north of Broadway	794	643	704	61	9.5
West Broadway east of Dorchester Avenue	672	612	612	0	0.0
West Fourth Street Bridge	887	920	920	0	0.0
Dorchester Avenue south of Old Colony Avenue	737	662	677	15	2.3
D Street south of Summer Street	612	683	729	46	6.7
Old Colony Avenue south of D Street	2,314	2,216	2,308	92	4.2
L Street south of Broadway	1,118	1,237	1,283	46	3.7

At Full Build in 1995, the greatest impact of the Fan Pier and Pier 4 Developments occurs at the entrance to the Seaport Access Road, where the projects add 700 vehicles in the afternoon peak hour. This represents a 43 percent increase over the No-Build volume. As a result of the heavy distribution of project traffic to the Seaport Access Road, project impacts at other locations are significantly less. Fan Pier/Pier 4 generated volumes add more than 420 vehicles to the Northern Avenue Bridge and 320 vehicles to Atlantic Avenue. In the same time period, the sites add 96 vehicles to the Congress Street bridge and similar volumes to Old Colony Avenue and Northern Avenue west of Ramp Street (92 and 91, respectively). The largest percentage increases in 1995 are on the Northern Avenue Bridge (20 percent), Atlantic Avenue (10 percent), and "A" Street (10 percent).

Intersection Analysis

The following pages summarize the 1995 No-Build and Build intersection levels of service for the morning and evening peak hours. The Existing Levels of Service section presented earlier provides an explanation of the terms level of service (LOS), volume-to-capacity (V/C) ratio, and available reserve capacity (ARC). The Appendix contains a detailed description of the traffic analysis procedure used to determine levels of service. Volumes used to calculate levels of service include the proposed shuttle bus demand as well as automobiles and trucks.

The results of the 1995 level of service analysis with the Third Harbor Tunnel and Seaport Access Road are summarized in Tables 21 and 22. In the morning peak hour, seven intersections will experience a decline in level of service from the No-Build to Build case. Six of those intersections will operate at Level of Service "D" or better while one would operate at Level of Service "F". Six of the seven intersections operating at Level of Service "E" or "F" under No-Build conditions would remain at those levels but would experience an increase in volume-to-capacity ratio or a decline in reserve capacity.

TABLE 21 Intersection Analysis - AM Peak Hour for Existing and 1995

			1995			
	Existing		No-Build		Build	
Location	V/C*	LOS**	V/C	LOS	V/C	LOS
East Broadway/L Street	0.53	A	0.57	A	0.58	A
West Broadway/D Street	0.64	B	0.65	B	0.66	B
Old Colony Avenue/ D Street	0.67	B	0.65	B	0.68	B
West Broadway/A Street	0.65	B	0.49	A	0.51	A
West Fourth/ Frontage Road	0.74	C	N/A	N/A	N/A	N/A
East Berkeley Street/ Albany Street	0.76	C	0.80	C	0.80	C
Herald Street/ Albany Street	0.55	A	0.68	B	0.68	B
Summer Street/Viaduct	0.53	A	0.54	A	0.57	A
Summer Street/ Atlantic Avenue	0.93	E	1.05	F	1.05	F
Northern Avenue***/ Atlantic Avenue	0.61	B	1.25	F	1.32	F
Congress Street/ Atlantic Avenue	0.83	D	1.26	F	1.32	F
Broadway Bridge/ Frontage Road	0.75	C	N/A	N/A	N/A	N/A
Summer Street/D Street	0.47	A	0.59	A	0.61	B
Andrew Square	0.71	B	0.78	C	0.79	C
High Street/ Atlantic Avenue	0.75	C	1.63	F	1.65	F

TABLE 21
(Continued)
Intersection Analysis - AM Peak Hour for Existing and 1995

			1995			
	Existing		No-Build		Build	
Location	V/C*	LOS**	V/C	LOS	V/C	LOS
Old Colony Avenue/ Dorchester Avenue	0.57	A	0.56	A	0.57	A
Northern Avenue/ Ramp Street	149	D	0	E	0	E
Day Boulevard/ L Street	352	B	30	E	2	E
Northern Avenue***/ Sleeper Street	242	C	0.44	A	0.47	A
New Northern Avenue/ Pittsburgh Street	N/A	N/A	0.50	A	0.58	A
New Northern Avenue/ Seaport Access Road Entrance	N/A	N/A	0.60	A	0.63	B
New Northern Avenue/ Seaport Access Road Exit	N/A	N/A	0.74	C	0.89	D
West Broadway/ Dorchester Avenue	0.86	D	0.75	C	0.75	C
Old Northern Avenue/ Farnsworth Street Extension	N/A	N/A	771	A	339	B
Old Northern Avenue/ Pittsburgh Street	N/A	N/A	337	B	242	C
Old Northern Avenue/ Seaport Access Road Entrance	N/A	N/A	0.29	A	0.46	A
Kosciuszko Circle	1.03	F	1.12	F	1.17	F

TABLE 21
(Continued)
Intersection
Analysis -
AM Peak Hour
for Existing
and 1995

Location	Existing		1995 No-Build		1995 Build	
	V/C*	LOS**	V/C	LOS	V/C	LOS
Congress Street/Seaport Access Road Entrance	N/A	N/A	0.52	A	0.61	B
Congress Street/Seaport Access Road Exit	N/A	N/A	0.87	D	1.10	F

* Volume-to-capacity ratio (available reserve capacity for unsignalized intersections).

** Level of Service

*** Old Northern Avenue for existing conditions, New Northern Avenue for future conditions.

N/A = Not Applicable. Location is either not in place under existing conditions or is eliminated under future conditions.

TABLE 22
Intersection Analysis - PM Peak Hour for Existing and 1995

Location	Existing		1995			
			No-Build		Build	
	V/C*	LOS**	V/C	LOS	V/C	LOS
East Broadway/L Street	0.49	A	0.54	A	0.54	A
West Broadway/D Street	0.67	B	0.64	B	0.65	B
Old Colony Avenue/ D Street	0.82	D	0.83	D	0.86	D
West Broadway/A Street	0.59	A	0.56	A	0.58	A
West Fourth/ Frontage Road	0.68	B	N/A	N/A	N/A	N/A
East Berkeley Street/ Albany Street	0.64	B	0.67	B	0.67	B
Herald Street/ Albany Street	0.69	B	0.80	C	0.80	C
Summer Street/Viaduct	0.46	A	0.66	B	0.70	B
Summer Street/ Atlantic Avenue	0.94	E	1.32	F	1.32	F
Northern Avenue***/ Atlantic Avenue	0.91	E	1.04	F	1.13	F
Congress Street/ Atlantic Avenue	0.88	D	1.06	F	1.11	F
Broadway Bridge/ Frontage Road	0.60	A	N/A	N/A	N/A	N/A
Summer Street/D Street	0.56	A	0.61	B	0.64	B
Andrew Square	0.52	A	0.63	B	0.64	B
High Street/ Atlantic Avenue	0.90	D	1.01	F	1.05	F

TABLE 22
(Continued)
Intersection Analysis - PM Peak Hour for Existing and 1995

Location	Existing		1995			
			No-Build		Build	
	V/C*	LOS**	V/C	LOS	V/C	LOS
Old Colony Avenue/ Dorchester Avenue	0.44	A	0.43	A	0.44	A
Northern Avenue/ Ramp Street	144	D	0	E	0	E
Day Boulevard/L Street	251	C	77	E	44	E
Northern Avenue***/ Sleeper Street	0	E	0.61	B	0.65	B
New Northern Avenue/ Pittsburgh Street	N/A	N/A	0.63	B	0.74	C
New Northern Avenue/ Seaport Access Road Entrance	N/A	N/A	0.97	E	1.21	F
New Northern Avenue/ Seaport Access Road Exit	N/A	N/A	0.94	E	0.95	E
West Broadway/ Dorchester Avenue	0.70	B	0.55	A	0.55	A
Old Northern Avenue/ Farnsworth Street Ext.	N/A	N/A	490	A	294	C
Old Northern Avenue/ Pittsburgh Street	N/A	N/A	665	A	181	D
Old Northern Avenue/ Seaport Access Road Entrance	N/A	N/A	0.25	A	0.68	B
Kosciuszko Circle	1.05	F	0.98	E	1.01	F

TABLE 22
(Continued)
Intersection Analysis - PM Peak Hour for Existing and 1995

Location	Existing		1995			
			No-Build		Build	
	V/C*	LOS**	V/C	LOS	V/C	LOS
Congress Street/ Seaport Access Road Entrance	N/A	N/A	0.89	D	0.94	E
Congress Street/ Seaport Access Road Exit	N/A	N/A	0.43	A	0.59	A

* Volume-to-capacity ratio (available reserve capacity for unsignalized intersections).

** Level of Service

*** Old Northern Avenue for existing conditions, New Northern Avenue for future conditions.

N/A = Not Applicable. Location is either not in place under existing conditions or is eliminated under future conditions.

Seven intersections will experience a decline in level of service from the No-Build to the Build case in the evening peak hour. Four of those intersections will operate at Level of Service "D" or better while three will operate at Level of Service "E". Eight of nine intersections operating at Level of Service "E" or "F" under No-Build conditions will stay at those levels but experience an increase in volume-to-capacity ratio or a decline in available reserve capacity.

Table 23 provides a summary of the number of intersections which will operate at Levels of Service "A" through "D" and Levels "E" or "F" for Existing, No-Build, and Build conditions. A summary is provided for both the morning and evening peak hours. Figure 13 shows 1995 deficient locations before mitigation. For both the AM and PM peak hours (without mitigation), the projects will cause one intersection to go from acceptable to deficient conditions. The Mitigation Measures section presented below identifies locations and specific mitigation measures which will address the intersection deficiencies identified.

TABLE 23
Summary of Traffic Analysis Results

Analysis Condition	Number of Locations Analyzed	Number of Analysis Locations			
		AM		PM	
		LOS A-D*	LOS E-F**	LOS A-D*	LOS E-F**
Existing	21	19	2	17	4
1995 No-Build	27	20	7	18	9
1995 Build	27	19	8	17	10

* Considered acceptable
** Considered deficient

Central Artery Analysis

The purpose of this section is to present any additional volumes that background and Fan Pier and Pier 4 Developments will contribute to critical Central Artery congestion points. The two congestion point locations presented are the high level bridge over the Charles River at the junction of I-93 and Route 1, and the Massachusetts Avenue interchange south of Downtown. At both locations, existing congestion defines capacity. Currently, there are plans under way to replace the existing I-93/Route 1 interchange with a multi-level, fully directional interchange. This will result in

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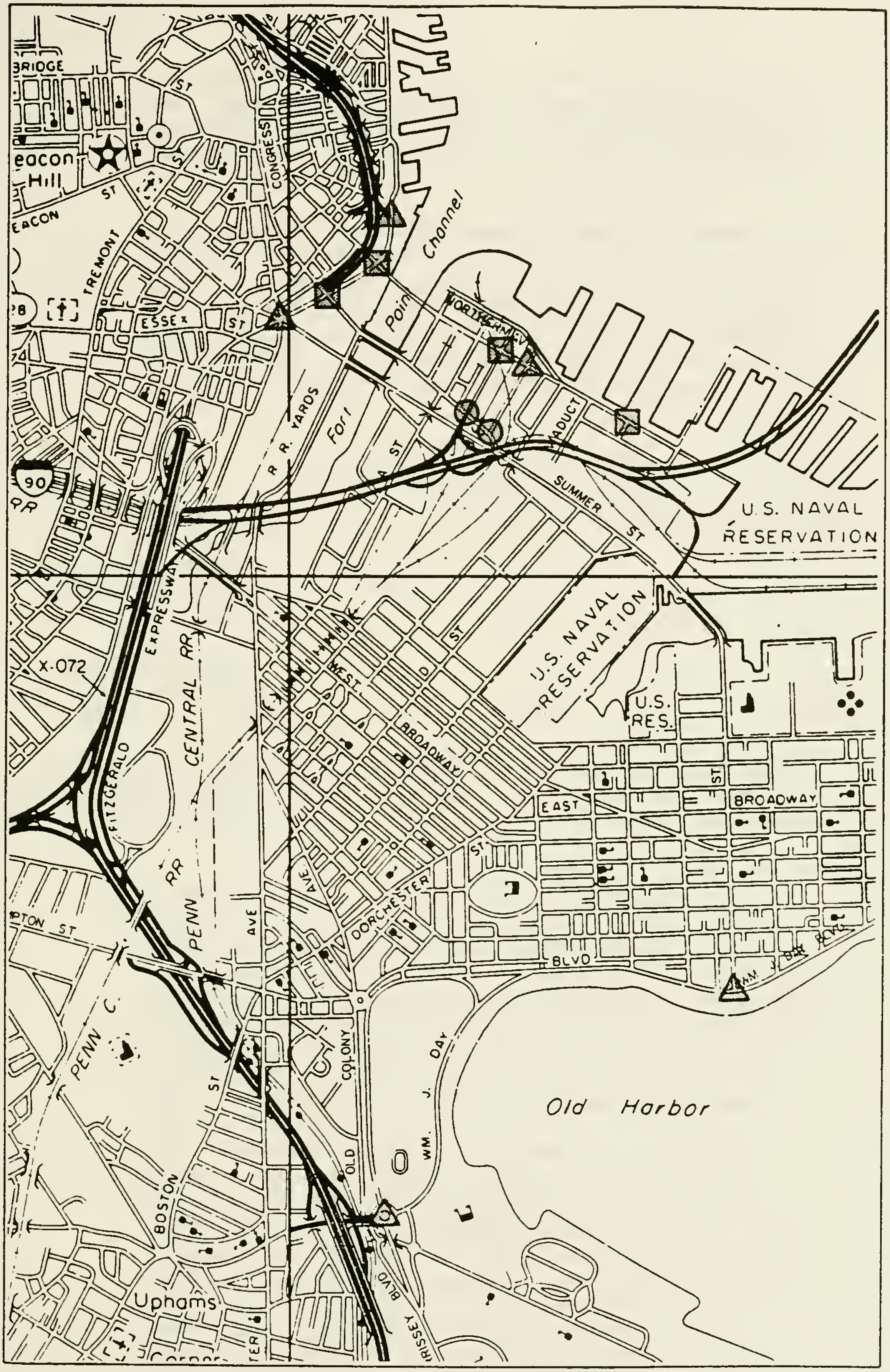

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increased capacity at this location and a reduction in the congestion that results from the limitations of the current interchange. However, even with the proposed improvements, this location will remain a limiting point in the overall capacity of the Central Artery.

Table 24 lists morning inbound volumes and evening outbound volumes approaching these locations in the peak hour. The morning approach volumes to the high level bridge are the total of vehicles approaching from both I-93 and Route 1 (Tobin Bridge). Volumes for the Fan Pier and Pier 4 Developments, background developments, and total traffic are shown for each location.

TABLE 24
1995 Central Artery Peak Hour Volume Increases

	Additional 1995 Volumes			
Time/Location	Fan Pier/ Pier 4	Background Development	Total Additional	Total Volume*
Morning Inbound				
High level bridge	325	709	1,034	6,023
Massachusetts Avenue	571	2,848	3,419	9,365
Evening Outbound				
High level bridge	373	804	1,177	5,098
Massachusetts Avenue	656	2,720	3,376	8,778

* 1995 total traffic volumes are interpolated from 1990 and 2010 volumes given in the Supplement to the 1983 Draft Environmental Impact Statement for the Third Harbor Tunnel.

In the morning peak hour, 1995 background and project approach volumes at Massachusetts Avenue total over 3,400 or 36 percent of total traffic volume. Project volumes account for about 6 percent of the total, while background volumes account for 30 percent. The project and background volume approaching the high level bridge is about 1,000 or almost 17 percent of the total. Approximately 5 percent is project-related while the remaining 12 percent is from background development.

In the evening peak hour, outbound project and background traffic at Massachusetts Avenue would total nearly 3,400 or over 38 percent of the total. Approximately 7 percent would be project-related, and 31 percent would be from background developments. At the high level bridge there would be a total of about 1,200 vehicles in project and background traffic, representing about 23 percent of the total volume. Background development would account for 16 percent of the total while the Fan Pier and Pier 4 Developments would contribute 7 percent.

Therefore, future queuing on I-93 is expected to continue to be significant prior to completion of the Depressed Central Artery. However, only 7 to 8 percent of the total volumes at the main congestion points will be contributed by the projects.

Roadway Deficiencies Summary

The intersection level of service analyses previously discussed provide a comparative basis for describing roadway conditions in the study area under varying volume conditions. In addition to these analyses, field observations have identified several locations throughout the study area where driver mobility is hindered.

There are many elements of urban streets that have an impact on operating conditions, and not all of these elements are included in capacity analysis techniques. For example, the effects of suboptimal signal timing, narrow lanes and double parking are not easily incorporated in the analysis techniques. Therefore, additional information developed for area roadways during travel time runs and physical inventories are noted in the subsequent paragraphs. The listing of these data provides a summary of observed operating conditions that lead to identification of potential problem areas as well as mitigation measures. These observations are summarized separately for the morning and evening peak hours. It should be noted that a traffic management mitigation plan for the area may be designed to alleviate some of the deficiencies and to maintain others where free traffic flow is not the highest priority for the South Boston community.

In the morning peak hour, the following factors have been identified as reducing traffic flow and restricting mobility:

- Narrow lanes, curb parking, and pedestrian crossings along L Street;
- Auto/truck conflicts along D Street;
- Inefficient signal timing and auto/truck conflicts along A Street;
- Heavy right turn volume from Broadway Bridge to Frontage Road confined to single lane;
- Short weave distance between Central Artery off-ramp and Northern Avenue along Atlantic Avenue. New Northern Avenue Bridge alignment will eliminate this difficulty;

- Heavy volumes creating congestion at bottlenecks on the Central Artery between the Massachusetts Avenue and Massachusetts Turnpike interchanges, and at the high level bridge over the Charles River. The latter problem will be partially ameliorated by the construction of new ramps and interchange at I-93 and U.S. 1; and

- Heavy undirected pedestrian activity at several intersections, particularly at Summer Street and Atlantic Avenue.

The following summarizes major system deficiencies in the evening peak hour:

- Narrow lanes, curb parking, and pedestrian crossings along L Street.

- Inefficient signal timing and on-street parking along Old Colony Avenue.

- Inefficient signal timing and auto/truck conflicts along A Street.

- Narrow travel lanes and short storage lanes combined with heavy volumes along Broadway under the Central Artery.

- Uncontrolled intersection and two heavy converging traffic streams at Northern Avenue and Atlantic Avenue. This intersection will be signalized with the realignment of Northern Avenue, but heavy volumes will still result in congestion and delays.

- Heavy volumes and congestion on the Central Artery between the Massachusetts Avenue and the Massachusetts Turnpike interchanges, and at the high level bridge over Charles River.

- Heavy undirected pedestrian activity at several intersections including Atlantic Avenue at Summer Street and Atlantic Avenue at Northern Avenue.

The above observations generally summarize major problems in the study area roadway system. The intersection level of service analyses provide a more quantitative indication of problems at specific intersection locations. Measures to mitigate the potential impact of development on these problem areas will address general traffic management problems as well as specific roadway capacity problems.

PARKING IMPACTS

Loss of Existing Commuter Parking

The proposed development of the Fan Pier will result in the elimination of the current surface parking lot used by daily commuters. As a result, under 1995 development assumptions, it will be necessary for these commuters to locate alternative parking or use other means of travel. Analysis of the parking situation in Boston indicates that no comparably-priced parking alternatives are likely to be available and that the commuters will have to use public transportation or rideshare with other commuters who have a Downtown parking space.

The EIR prepared for International Place projected a deficit of 1,625 parking spaces in Downtown Boston under 1990 Build conditions. This projection was based on several assumptions including: the elimination of 2,000 spaces from the Fan Pier; construction of 2,250 new public spaces at South Station; reconstruction and expansion of the Post Office Square Garage to add 500 spaces; and the new availability of 250 existing spaces because of shifts to new parking at North Station. In addition to the International Place analysis, the 1983 report, "Parking in Central Boston," projected that parking demands in the financial district and South Station area will exceed available supply by 7,964 spaces in 1990. Based on this projected deficit, there would be no space available for the 1,125 vehicles currently parking on the Fan Pier.

If the 1990 projected 1,625-space deficit in Downtown were to be eliminated by increased ridesharing, the average work-trip vehicle occupancy rate (VOR) would have to increase by 14 percent. Such an increase is highly unlikely considering the downward trend in the overall VOR reported in the 1982 Cordon Count. According to that study, the overall average VOR had dropped from 1.57 in 1972 to 1.42 in 1982. It is estimated that if only one-third of the parking shortfall was made up by a shift to ridesharing, the average work trip VOR would still need to increase by 5 percent.

Those drivers who do not rideshare with other Downtown parkers would have to shift to public transportation. Table 25 shows the expected changes in Downtown VOR that would be associated with different levels of shifts to ridesharing and projects the additional transit trips which would result from current Fan Pier parkers at the different levels of shifts. The range runs from a 100 percent shift to rideshare (no impact on traffic or transit) to no shift (worst case for transit). The

projected increases in VOR associated with various levels of shifts are based on the International Place analysis described previously.

TABLE 25
Shift of Current Fan Pier Parkers to Transit and Ridesharing

Percent of Downtown Displaced Parkers Shifting to Ridesharing	Percent Increase in Downtown VOR*	Additional Transit Trips** from Current Fan Pier Parkers		
		Daily	AM Peak	PM Peak
100%	14%	0	0	0
50%	7%	1,700	385	345
33%	5%	2,266	514	460
0%	0%	3,398	767	690

* VOR - vehicle occupancy rate. Percent increases taken from International Place EIR.

** Based on an assumed VOR of 1.51 multiplied by the current trips to and from the parking lot.

The table estimates transit trips from the shifts of Fan Pier parkers assuming a VOR of 1.51 for vehicles currently parking on the Fan Pier. This rate was applied to work trips in "Parking in Central Boston," and is based on the overall average VOR of 1.42 from the 1982 Cordon Count. In the worst case, all current Fan Pier parkers would shift to transit. As a result, an estimated 3,400 trips daily would be added to the various public transportation services. In the morning peak hour, there would be almost 770 new transit trips, and in the evening peak hour, there would be approximately 690 new transit trips. To be conservative, the worst case assumption is used to estimate the impact of Fan Pier parkers on the transit system in the Public Transportation section.

Project Parking Demand and Supply

The focus of discussion on project parking demand and supply is on office and retail uses because the hotel and residential uses have allocated parking reserved exclusively for those uses. Fan Pier proposes 450 spaces for hotel users and 554 spaces for residential. Pier 4 will prove 290 parking spaces for the hotel and 850 spaces for residential users.

The number of parking spaces required by the office and retail uses for the Fan Pier and Pier 4 Developments was estimated from the vehicle-trip generation projections. Parking requirements are divided into long-term employee parking and short-term business/shopping parking.

Turnover rates of 1.0 for long-term (work-related) parkers and 2.67 for short-term (non-work related) parkers were assumed based on information presented in "Parking in Central Boston."

Based on the mode split assumptions described earlier in this chapter, a total of over 2,400 spaces will be needed to satisfy the projected demand of the project's office and retail uses at Full Build. As shown in Table 26, approximately 1,540 spaces would be required to meet Fan Pier demand and 878 spaces would be needed to meet Pier 4 demand.

TABLE 26
Project Office and Retail Parking Demand

Location	Long-term	Short-term	Total
Fan Pier	1,082	458	1,540
Pier 4	542	336	878
Total	1,624	794	2,418

The proposed supply of office and retail parking spaces on Fan Pier and Pier 4 is shown in Table 27. A total of 2,646 spaces will be provided for the office and retail uses. It should be noted that the number of retail spaces on Pier 4 does not include 360 spaces to be used by Anthony's Pier 4 Restaurant customers. The balance of the Pier 4 retail spaces will be restricted to use after the AM peak commuter hour, thus discouraging all-day use. For economic reasons, the developer will hold those spaces out of the long-term market and reserve them for short-term use.

TABLE 27
Proposed Office and Retail Parking Supply

Location	Office	Retail	Total
Fan Pier	1,325	171	1,496
Pier 4	572	578*	1,150
Total	1,897	749	2,646

* Does not include 360 spaces used by existing Anthony's Pier 4 Restaurant during daytime period. The remaining spaces will be restricted to use after the AM peak period so as to discourage automobile commuters.

The proposed office-related parking supply of one space per 1,000 square feet of office space exceeds that generally provided by Downtown developments. Because of the large supply of retail spaces proposed for Pier 4, all short-term parking demand generated by Pier 4 will be satisfied, resulting in a surplus of 242 short-term spaces. These spaces will be available to meet short-term demand generated by other development in the area. Long-term demand for 542 spaces on Pier 4 will be satisfied by the provision of 572 office-related spaces. On the Fan Pier, the total long- and short-term demand of 1,540 spaces will slightly exceed the office and retail supply of approximately 1,500 spaces. Therefore, the proposed parking supply will not provide any excess space which would allow additional commuting by automobile above the level anticipated under the trip generation assumptions.

PUBLIC TRANSPORTATION IMPACTS

Transit Trip Generation

Based on the trip generation assumptions referenced previously, the proposed Fan Pier and Pier 4 Developments will generate 23,720 transit trips daily at Full Build. As shown in Table 28, approximately 3,400 inbound transit trips would occur in the morning peak hour, and about 3,600 outbound trips would occur in the evening peak hour.

TABLE 28
1995 Project-Related Transit Trip Generation

	Fan Pier	Pier 4	Project Total	Current Fan Pier Parkers*	Total
Daily	17,060	6,660	23,720	3,398	27,118
AM Peak					
In	2,444	950	3,394	767	4,161
Out	261	156	417	0	417
Total	2,705	1,106	3,811	767	4,578
PM Peak					
In	417	214	631	27	658
Out	2,598	1,015	3,613	663	4,276
Total	3,015	1,229	4,244	690	4,934

* Worst case scenario based on all parkers currently using Fan Pier shifting to transit.

In addition to the transit trips generated by the new construction on the site, the proposed projects will also create additional transit demand by displacing the commuters who currently park at the Fan Pier. As discussed previously, these displaced parkers will likely be unable to find comparably priced alternative parking. As a result, they are expected to use transit or carpool with others. The maximum impact on public transportation will occur if none carpool and all use transit. When the displaced parkers are combined with the transit trips generated by Fan Pier and Pier 4, the result is a total of almost 4,200 new inbound transit trips in the morning peak hour and almost 4,300 new outbound transit trips in the evening peak hour.

Other development activity will also generate new demands for transit service. In addition to the Downtown and South Boston background developments considered in the traffic impact analysis, developments in Cambridge along the Red Line were included in background transit trip generation. In all, seven transit background developments are located in South Boston, 20 are Downtown, and seven are in Cambridge.

Other developments Downtown, in South Boston, and in Cambridge are expected to generate approximately 28,650 new inbound transit trips in the morning peak hour and almost 29,000 new outbound trips in the evening peak hour. About 72 percent of these background trips will be generated by Downtown development, 19 percent by Cambridge projects, and 9 percent by South Boston developments.

This projection of background transit trips is based on those developments listed in the Appendix as transit background developments. In order to account for future shifts to transit because of projected Downtown parking deficits and any other development not included as background, an additional one percent increase in current ridership was projected for each line. The one percent increase is not included in the background transit volumes given above, but is reflected in 1995 No-Build and Build transit volumes.

Shuttle Bus System

A major component of the future transit system in the project area will need to be a high frequency transit connection to link South Boston developments to the full array of transit services available Downtown. Such a connection can be provided by a fixed guideway system, which will be explored in the World Trade Center EIR, or by a shuttle bus system, which is explored in detail in

the mitigation section. It is felt that a well planned and designed bus system such as is detailed in this Access Plan can satisfactorily accommodate project and background passenger demands well into the future, until such time as a more permanent fixed guideway system is in place.

In this section, the proposed shuttle system is described in terms of service quality because, from the passenger's viewpoint, quality of service is essential to achievement of the desired transit mode split. The high-quality service proposed, in turn, raises several operational questions: How will the service work from an operator viewpoint, who will be responsible for it, who will actually operate it, what will it cost, and how will the costs be paid? While the shuttle system is not a mitigation action per se, the mitigation section is the appropriate place to address the latter type of question. Therefore, cost information, together with operational data used to derive those costs (e.g., routings, passenger volume, vehicle capacity, fleet size requirements and unit costs) are presented under Mitigation Measures.

In brief, the proposed shuttle system will connect four Downtown transit nodes (South Station - Red Line, bus, rail; Government Center - Green and Blue Lines; Haymarket - Green and Orange Lines, bus; and Aquarium - Blue Line, boat) with four stops in South Boston, serving the Fan Pier, Pier 4, Cabot Cabot & Forbes, Commonwealth Pier, Fish Pier and Commonwealth Flats. The transit analysis assumes that no fares will be collected on the bus itself so as to optimize the service level provided.

The shuttle bus system will provide direct non-stop or limited-stop service on reliable full-size transit buses, with minimal wait times and very short walk distances. Service will be bi-directional at all times. Because the service concept is a point-to-point shuttle, rather than a typical local bus route, most riders will have non-stop service, and the vast majority will stop at no more than one bus stop between boarding and alighting. For most people using public transit to reach the sites, the shuttle will be by far the most convenient link of their journey.

In the morning peak hour, passengers bound for South Boston will be able to board shuttles at South Station, Government Center or Haymarket. This means that shuttles will connect directly with every rapid transit line, all private carrier and MBTA express buses, and all South Station commuter rail routes. The Haymarket

shuttle stop is just a 1/4-mile walk from the North Station commuter rail terminal. Since all transit lines are served directly, no transfers between lines are necessary to reach the shuttle.

Shuttles from South Station will reach their destinations in just five or six minutes, traveling via exclusive high-occupancy vehicle lanes on the Seaport Access Road. These shuttles will offer non-stop service to each of two points on Old Northern Avenue as well as to Commonwealth Pier. Shuttles to Commonwealth Pier will make a subsequent stop at Commonwealth Flats.

Passengers boarding shuttles at Government Center or Haymarket will reach their destinations in 10 to 15 minutes, traveling via Congress Street. In South Boston, these shuttles will provide non-stop service to two Old Northern Avenue points and to Commonwealth Flats, and one-stop service to Commonwealth Pier.

In the PM peak hour, shuttles will travel from the same South Boston points to South Station, making the trip in five or six minutes via the exclusive high-occupancy vehicle lanes. Shuttles will also carry passengers up Atlantic Avenue to Aquarium Station in 5 to 10 minutes. The trip via shuttle to Government Center will take 15 to 20 minutes depending on Downtown traffic conditions.

All travel time forecasts have taken into consideration the traffic level of service impacts of 1995 project and background development as well as the recommended traffic mitigation measures discussed later in this report. Also taken into account was the travel time improvement recently achieved when the City of Boston Transportation Department cleared Congress Street of all parked and double parked cars.

Each shuttle route will provide very frequent service. On average, shuttle riders will wait two minutes for service during both the AM and PM peak hours. On the least frequent shuttle route, average wait time will be less than four minutes in both peak hours.

During the remainder of the 13-hour service day, all shuttle stops Downtown and in South Boston will continue to be served. Fewer riders will have non-stop service, but the resulting delays may be offset by higher travel speeds (due to lighter off-peak traffic levels). During off-peak periods, all shuttles will operate at 10-minute intervals and, therefore, average wait time will be about five minutes. Wait times of this magnitude are viewed by most passengers as minimal.

Suburban Express Bus System

As an added convenience for public transportation users, a network of suburban express buses will likely serve South Boston directly via the Seaport Access Road. For-profit commuter bus services have grown significantly during the past 10 years and ridership on MBTA express routes has also increased. The 1982 Cordon Count shows that 18 to 19 percent of all peak hour, peak direction transit passengers crossing the Downtown cordon line were on buses. A review of existing service and ridership suggests several financially viable express routes to South Boston, which together would capture about 13 percent of all peak hour transit trips. The most promising suburban destinations are Newton Corner, the Riverside MBTA Station and the Rockland Park-and-Ride Lot on the South Shore. It is also likely that some of the MBTA's North Shore buses, which now serve Haymarket Station via the Sumner Tunnel, will be rerouted to South Boston via the Third Harbor Tunnel, with a stop in South Boston. Suburban express buses are discussed further under Mitigation Measures.

Transit Trip Assignment

The assignment of transit trips to the various transit modes and lines was based on the 1982 Cordon Count for Downtown Boston, 1980 Census journey-to-work data for South Boston, and existing rapid transit usage. As shown in Table 29, the 1982 Cordon Count indicates that 68 percent of PM peak hour transit trips leaving Downtown were on rapid transit, 18 percent were on buses, and 14 percent were on commuter rail. The 1980 Census data for South Boston indicate a larger share of bus trips and a smaller share of rapid transit trips than observed Downtown. This reflects the greater accessibility to buses than to rapid transit lines.

Transit trips were assigned to the major transit modes based on the type and location of the developments. The 1982 Cordon Count distribution was used for the six South Boston developments located near the Fort Point Channel along Northern Avenue and for all Downtown developments. The South Boston census data were used for the three South Boston developments that are located away from the project sites. This approach was selected based on the assumption that, given their accessibility to all Downtown transit lines, the proposed projects and other nearby developments would have a transit mode use pattern similar to Downtown. For Cambridge developments, the cordon count mode split was adjusted by reducing the commuter rail share and increasing the bus share, based on the transit analysis in the Draft EIR

for University Park. Table 30 shows the assignment of Fan Pier/Pier 4 and background peak hour trips to major transit modes.

TABLE 29
Distribution of Peak Hour Transit Trips by Mode

Mode	Line	1982 Cordon Count (Downtown)	1980 Census (South Boston)*
Bus	Local	N/A	33%
Express	N/A	7%	
Total	18%	40%	
Rapid Transit	Red	N/A	22%
	Orange	N/A	15%
	Green	13%**	10%
	Blue	N/A	7%
	Total	68%	54%
Commuter Rail	North	N/A	1%
	South	N/A	5%
	Total	14%	6%
Total		100%	100%

* Journey-to-work data for census tracts 606 and 614 which generally include areas of South Boston north of the Reserved Channel and Summer Street and west of D Street south to Dorchester Avenue. Distribution by line within each mode estimated from geographic distribution by city and town.

** Percent distribution by "streetcar".

The transit analysis concentrates on the rapid transit system because its capacity will be relatively fixed and because it carries such a large share of total transit trips. As previously described, each rapid transit line can only accommodate a fixed number of cars per train. On some lines, peak hour train frequencies are near the maximum limit. In contrast, the commuter rail system can be expanded by the addition of cars to existing trains or by the scheduling of additional trains. The capacity of the bus system can also be expanded by operating additional vehicles.

TABLE 30
New Peak Hour 1995 Transit Trips by Mode

Mode*	Fan Pier/ Pier 4** AM In	Fan Pier/ Pier 4** PM Out	Background*** AM In	Background*** PM Out	Total AM In	Total PM Out
Bus	749	770	5,850	5,903	6,599	6,673
Rapid Transit	2,830	2,908	19,612	19,813	22,442	22,721
Commuter Rail	582	598	3,188	3,245	3,770	3,843
Total	4,161	4,276	28,650	28,961	32,811	33,237

* No commuter boat assignment is made because current usage is not a significant share of total transit.

** Includes current users of Fan Pier parking lot.

*** Based on transit background developments listed in the Appendix.

Rapid transit trips were assigned to the various lines based on the distributions shown in Table 31. Trips to and from three South Boston background developments (Boston Wharf Properties, Boston Marine Industrial Park, and Gillette) were assigned using the distribution based on the census data for South Boston. For all other developments, as well as displaced Fan Pier parkers, assignments were based on existing line ridership.

TABLE 31
Assignment of New Rapid Transit Trips by Line

Line/Segment	Boston Wharf BMIP, and Gillette*	Project, Downtown and other South Boston**
Red/North	14%	12%
Red/South	27%	23%
Green/West	16%	17%
Green/North	3%	2%
Orange/North	17%	20%
Orange/South	11%	14%
Blue/North***	12%	12%
	100%	100%

* Based on 1980 Census journey-to-work data.

** Based on existing rapid transit ridership.

*** No assignment is made for the Blue Line to Bowdoin as it would principally accommodate transfers to other lines.

Rapid Transit Analysis

In order to provide a basis for evaluating the impacts of the No-Build and Build alternatives on the rapid transit system, Table 32 compares current ridership to current planning capacity. Trains on the Orange Line/ North are currently somewhat overcrowded during the PM peak hour. Ideally, that segment should have 10 percent more capacity than it does currently. However, a 110 percent utilization rate usually would not cause severe problems, and the current capacity may even be a reasonable target given the underutilization (76 percent) on the south half of the line. The Green Line/West operates at an unacceptable 133 percent of planning capacity. This level of capacity shortfall causes severe operational problems including excessive dwell times, which result in further capacity losses.

TABLE 32
Existing Rapid Transit Capacity and Ridership: PM Peak Hour Outbound

Line	Existing Planning Capacity*	Existing Ridership**	Ridership as Percent of Capacity
Red Line/North	10,800	7,140	66%
Red Line/South	11,520	11,190	97%
Green Line/West	7,500	10,000	133%
Green Line/North	2,600	1,100	42%
Orange Line/North	9,300	10,270	110%
Orange Line/South	9,300	7,080	76%
Blue Line/North	6,600	6,120	93%

* See Table 8.
** See Table 9.

The impact of the proposed Fan Pier and Pier 4 Developments on the rapid transit system's seven peak load points will be to increase ridership by 4 percent over the No-Build alternative. As shown in Table 33, the Fan Pier and Pier 4 Developments are expected to add approximately 2,800 inbound transit trips in the morning peak hour. In the evening, 2,900 outbound trips are expected. These projected volumes include transit trips made by the current users of the Fan Pier parking lot. Background developments will have a much greater impact, generating approximately 17,700 inbound trips through

peak load points in the morning and 17,900 outbound trips in the evening. These background rapid transit volumes are less than the rapid transit volumes shown in Table 29 because some rapid transit trips to and from Cambridge background developments will not pass through peak load points and, hence, are not included in the rapid transit capacity analysis.

TABLE 33
New Peak Hour Rapid Transit Trips by Line

Line/ Direction	Fan Pier/Pier 4* In AM	Fan Pier/Pier 4* Out PM	Background** In AM	Background** Out PM	Total In AM	Total Out PM
Red/North	340	349	1,868	1,900	2,208	2,249
Red/South	651	669	3,979	4,015	4,630	4,684
Green/West	482	494	2,755	2,789	3,237	3,283
Green/East	56	58	331	335	387	393
Orange/North	565	581	3,843	3,886	4,408	4,467
Orange/South	396	407	2,684	2,711	3,080	3,118
Blue/North	340	349	2,272	2,299	2,612	2,648
Total All Lines	2,830	2,907	17,732	17,935	20,562	20,842

* Includes current users of Fan Pier parking lot.
** Based on developments listed as transit background projects in the Appendix. Includes only those trips which pass through peak load points in the peak direction for the system.

Future rapid transit line capacities are shown in Table 34. They are based on MBTA plans to increase average train lengths on the Red, Orange and Green Lines. Six-car trains will operate at currently observed frequencies on the Red Line, resulting in a 50 percent capacity increase. On the Orange Line, six-car trains will operate at slightly lower frequency (4.5 minute headway versus current four-minute headway) for a 33-percent capacity increase.

The Green Line forecast is somewhat more complex. The MBTA operations department has identified four major Green Line improvements which, together with increased operating funds, would expand westbound PM planning capacity from the current 7,500 passengers (58 cars) per

hour to a goal of 14,300 passengers (110 cars) per hour. These improvements are:

1. Purchase 100 new LRVs, thus adding significantly to the current fleet of 124 active cars.

2. Upgrade the power system to propel three-car trains.

TABLE 34
1995 Rapid Transit Line Capacity: PM Peak Hour

Line/Segment	Average Cars/ Train	Average Headway* (minutes)	Average No. of Trains	Car Capacity**	Line Capacity
Red Line/North Ashmont-Alewife Braintree-Alewife	6	4	15	180	16,200***
Red Line/South Alewife-Ashmont Alewife-Braintree Park-Quincy	6	3.75	16	180	17,280
Green Line/West Boston College Cleveland Circle Riverside Huntington Avenue	2.65****	1.62	37	130	12,740
Green Line/North Lechmere Service	2	6	10	130	2,600
Orange Line/ North-South Oak Grove-Forest Hills	6	4.5	13.33	155	12,400
Blue Line Bowdoin-Wonderland	4	4	15	110	6,600

* Projected headways are based on maintenance of existing headways except on the Orange Line where a slight increase is planned by the MBTA.

** The MBTA uses these capacity estimates for planning purposes. Heavier loads can be carried and are often observed on the system.

*** Capacity is slightly lower than Red Line/South because the Quincy-Park run is not included.

**** Represents 13 two-car trains (mostly serving Huntington Avenue and Lechmere) and 24 three-car trains on other lines.

3. Lengthen platforms at Science Park (an elevated station) and at certain surface-line stations to accommodate three-car trains on all lines except Huntington Avenue.

4. Upgrade the signal system to allow scheduling of 75-second average headways in the central subway.

The first three actions will allow for longer trains, while the fourth project would allow more trains to flow through the stations during the peak hour.

The Green Line capacity forecast of 12,740 passengers in 98 cars per hour used in this Access Plan (as opposed to the MBTA goal of 14,300 passengers in 110 cars per hour mentioned above) accounts for the 100 new LRVs, the last of which are scheduled for delivery in 1987. The power system upgrade, although not yet fully funded, is seen by the MBTA as quite certain to be complete before 1994 and, therefore, is also assumed in this forecast. Funding for Green Line platform extensions is not definite; this report presumes that the inexpensive extensions (those at surface line stations), but not the more costly Science Park extension, will be completed. The signal system upgrade is not assumed, since its funding is uncertain and, more importantly, there is disagreement among MBTA officials as to whether the project would increase capacity, or only reliability.

These assumptions lead to the conclusion that the Green Line PM peak hour service in 1994 will consist of 13 two-car LRV trains, most of which will serve Huntington Avenue and Lechmere, and 24 three-car LRV trains distributed among the other three branches. The total number of trains per hour is 37, which the existing signals already handle. The increased capacity results from longer trains.

The projected volumes shown in Table 35 indicate that when both background development and the Fan Pier and Pier 4 projects are built, ridership will be under planning capacity on four rapid transit line segments, and over planning capacity on three. The Blue Line, for which no capacity increases have been announced by the MBTA, will operate at 134 percent of planning capacity. For comparison, the Green Line/West currently operates at 133 percent of capacity. Therefore, this projection means that overcrowding on the Blue Line in 1995 will be comparable to that seen on the Green Line today, unless new capacity is added as discussed under Mitigation Measures.

TABLE 35
1995 Rapid Transit Ridership and Capacity: PM Peak Hour

Line/ Segment	1995 Planning Capacity*	1995 No-Build		1995 Build	
		Ridership	Percent of Capacity	Ridership*	Percent of Capacity
Red/North	16,200	9,111	56%	9,460	58%
Red/South	17,280	15,317	89%	15,986	93%
Green/West	12,740	12,889	101%	13,383	105%
Green/North	2,600	1,446	56%	1,504	58%
Orange/North	12,400	14,259	115%	14,840	120%
Orange/South	12,400	9,862	80%	10,269	83%
Blue/North	6,600	8,840	128%	8,829	134%

* Car capacities are the planning figures used by the MBTA. Heavier loads can be carried and are often observed on the system.

** Includes a one percent growth factor plus the impacts of all transit background developments listed in the Appendix.

In summary, the projection of Fan Pier and Pier 4 transit trips was based on high transit mode split trip generation assumptions and includes transit trips generated by the current users of the Fan Pier parking lot. Transit trips from other developments include all Downtown and South Boston background developments identified for the traffic analysis as well as Cambridge developments served by the Red Line. Also included is a generalized growth factor to account for shifts to transit at existing developments and other potential development by 1995.

MITIGATION MEASURES

As a result of the many public and private projects, including the Fan Pier and Pier 4 Projects, that have been or will be developed along Northern Avenue, in the Commonwealth Flats development area, and Downtown travel demand increases can be expected throughout the study area through the end of the century. As demonstrated in the preceding impact analysis, some systems in the study area will be able to absorb the cumulative growth from all developments and still maintain acceptable levels of service. Others will be handling volumes at or in excess of their capacity during the peak hours unless mitigation measures are implemented.

Most of the study area's future estimated traffic will occur even without the proposed Fan Pier and Pier 4 Developments because of the continuing growth trend in the area. The developers are concerned with issues related to traffic growth and feel it is important to outline a comprehensive program of measures to mitigate potential adverse impacts, especially for the South Boston residential community. The developers have included mitigation measures in three general categories: Traffic Operations Improvements, New Roadway Capacity, and Demand/Reduction Management. These measures address not only the developers' projects, but also the larger issue of areawide traffic growth caused by other developments in South Boston and Downtown.

The provision of transit service is not viewed as a mitigation measure since extensive improvements in bus transit have been assumed in base planning parameters for the projects. The developers concur with state and city officials that development of the overall Fort Point Channel/Northern Avenue/Commonwealth Flats area requires upgrading of public transportation to accommodate long-term development potentials. They are also committed to working with all area developers and transit operators to assure that the appropriate systems are in place as development occurs. A primary thrust of Final EIR transportation planning has thus been to devise a system of transit improvements which are necessary to meet travel demands generated by developments anticipated in the area by 1995, and are expandable to meet travel demands generated by future developments in the nearby area over the long-term. Accordingly, the detailed operational characteristics of a transit service capable of being implemented and fully operational in 1995 are included in this Mitigation Measures section.

Currently, the World Trade Center developers and city/state agencies are studying the potential of a people mover as a long-term solution for the Northern Avenue/Commonwealth Flats area. Therefore, no analysis of a people mover is included in this Access Plan. The proponents of the Fan Pier and Pier 4 projects look forward to reviewing the feasiblity analysis of such a system and see it as complementary to the bus system designed and analyzed for this Plan.

Many of the specific suggestions to relieve impacts in the study area are dependent on actions by governmental agencies. The developers are committed to working with the city and state to insure that a meaningful program of mitigation actions is identified and implemented.

Particular attention in defining this program will be given to the Fan Pier and Pier 4 Citizens Advisory Committee (CAC) and local residents so that mitigation actions respond to their concerns.

The Mitigation Measues section is organized as follows:

- First, there is a discussion of transit services necessary to link MBTA service to the Northern Avenue/Commonwealth Flats development area, and to provide supplementary direct line haul service from suburban locations. The discussion concentrates on bus systems as agreed to with MEPA. The World Trade Center's expected EIR on their proposal for Commonwealth Flats will concentrate on fixed guideway (people mover) applications.

- Second, "Traffic Operations Improvements" that would be required at locations exhibiting significant deficiencies in capacity are described. Most of the anticipated traffic problems in South Boston will occur even without the Fan Pier and Pier 4 Projects and these recommendations are made irrespective of these projects.

- Third, proposed measures dealing with "New Roadway Capacity" are described. These are compatible with the I-90/I-93 project.

- Fourth, a comprehensive program of "Demand Reduction/Management" measures is presented. This includes options that are aimed at reducing vehicle traffic by encouraging other travel modes or by managing vehicle traffic more efficiently to reduce peak hour impacts. Implementation of these measures would result in much improved mobility in the study area and in the larger Boston region.

- Finally, an analysis summary is provided which identifies the likely results at key analysis locations of the combined set of mitigation actions in the traffic operations and roadway network categories. A qualitative evaluation is also provided of the likely impact of measures in the "Demand Reduction/ Management" category.

Table 36 summarizes the full mitigation program discussed on the following pages and indicates the implementing agency or organization for each measure. It should be noted that although the program focuses on the 1995 Full-Build case, planning should begin now for early implementation of many of these measures to manage existing traffic and traffic growth over the next

TABLE 36
Summary of Mitigation Measures and Proponent Commitments

Category	Mitigation Measure	Implementing Agency	Proponent Commitments
Required Transit Services	o Shuttle bus system	o MBTA	Assistance in operation planning, on-site improvements for boarding/alighting areas, and interim service contract prior to public operation
	o Suburban express bus system	o MBTA, Private bus operators	Assistance to operators for route planning
Traffic Operations Improvements	o Intersection-Related improvements	o BTD	Planning services for intersection design
	o Arterial-Related improvements	o BTD, MDC	Planning service and contribute funds for engineering and streetscape improvements
	o System-Related improvements	o BTD	Work with city to devise delivery vehicle scheduling policy
	o South Boston Transportation Study	o BTD	Partial funding of study
New Roadway Capacity	o Advance construction of links to Seaport Access Road	o BTD, MDPW	Planning services
	o South Boston Bypass Road	o MDPW, BTD	Planning services
	o Reopening of Dorchester Avenue	o BTD, MDPW, USPS	Planning services
Demand Reduction/ Management	o MBTA rapid transit improvements	o MBTA	Planning assistance
	o Water shuttle	o MBTA, BRA, EOTC, Massport	Feasibility study completed. Boat landings and passenger facilities to be provided on site. Provision of promotional materials to tenants
	o Water taxi	o MBTA, BRA, EOTC	Pier 4 to initiate and operate water taxi.
	o Pedestrian access	o BTD, BRA, MDPW	Old Northern Avenue to have ample pedestrian environment funded by proponents
	o Agency coordination and liaison	o Various agencies, Fan Pier/Pier 4 developers	Provide continuing planning services to agencies

• BRA = Boston Redevelopment Authority
BTD = Boston Transportation Department
CTPS = Central Transportation Planning Staff
EOTC = Executive Office of Transportation and Construction
Massport = Massachusetts Port Authority
MBTA = Massachusetts Bay Transportation Authority
MDC = Metropolitan District Commission
MDPW = Massachusetts Department of Public Works
USPS = United States Postal Service

several years from background developments as well as the proposed projects.

Several improvements to the existing roadway and transit systems are included under the mitigation measures although they have also been included in the 1995 Build analysis presented in the Probable Project Impacts section. These have been described previously but are also included here because certain aspects of these measures involve actual mitigation actions on the part of the developers or an implementing agency. They include the expansion of the public transportation system to include a shuttle bus link between Downtown and South Boston and express bus service to South Boston; advanced construction of the ramp links to the Seaport Access Road; and lane use modifications along Relocated Northern Avenue and intersecting streets.

REQUIRED TRANSIT SERVICES/ROUTES

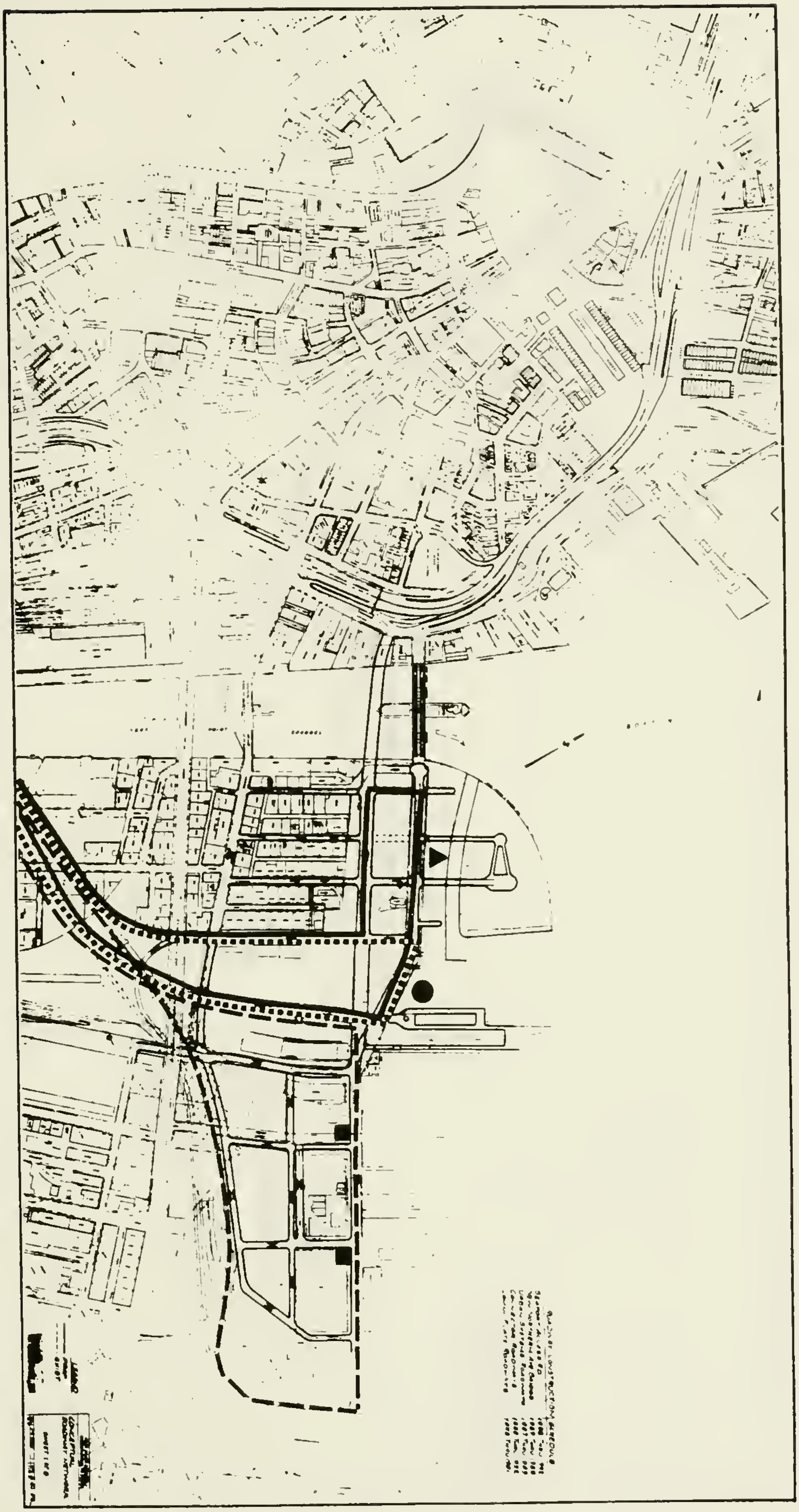
Shuttle Bus System

The shuttle system introduced in the Probable Project Impacts Section will consist of six routes. The South Boston development zone is divided into three areas (eastern, central, and western), each of which will be served by two routes: one to South Station, and one to Government Center. The three Government Center routes will also serve Haymarket and Aquarium. Figure 14 displays the three shuttle routes to South Station, while Figure 15 shows the three shuttle routes to Government Center.

The eastern area routes will serve Commonwealth Pier, the Fish Pier, and Commonwealth Flats. The central area routes will serve Pier 4 and the easternmost Fan Pier office building fronting on Relocated Northern Avenue. The western area routes will serve the Fan Pier Development, except the easternmost parcel, and future development at CC&F.

South Station shuttles will travel via the Seaport Access Road (SAR) high-occupancy vehicle (HOV) lane to the SAR Exit Road. Those serving the central area will travel just one block west on Old Northern Avenue before returning via the SAR Entrance Road. Their stop will be the east half of the Pier 4 parcel on Old Northern Avenue, where a sheltered waiting area will be provided. Those shuttles serving the western area will follow Old Northern Avenue all the way to Sleeper Street, stopping at the Fan Pier parcel west of Pittsburgh Street, where a sheltered waiting area will be provided, and returning to the SAR Entrance Road via Relocated Northern Avenue.

FIGURE 14
Peak Hour
South Station
Shuttle
Routes



━━━━
Western
Area Route

••••••••••
Central
Area Route

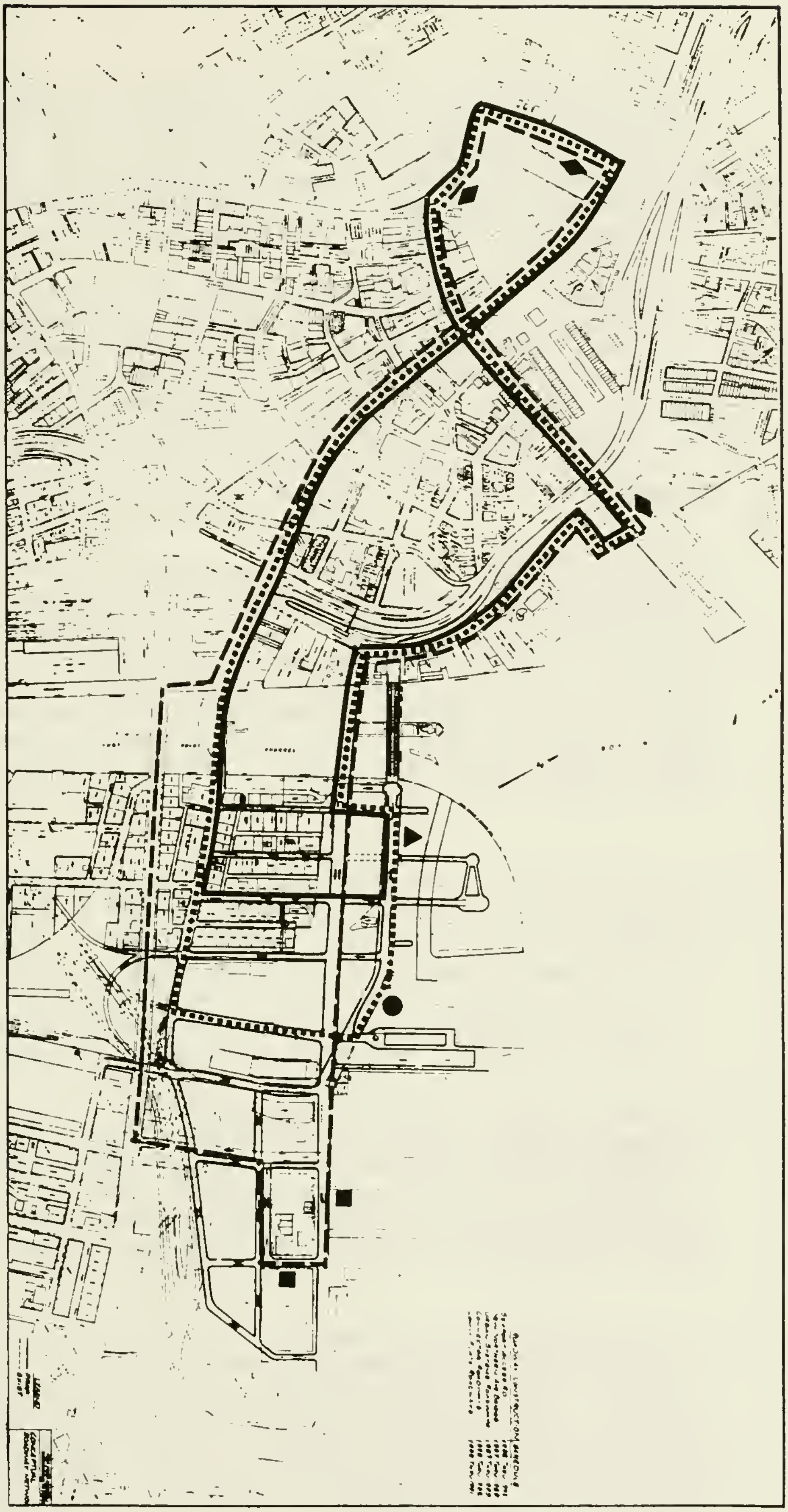
— — —
Eastern
Area Route

▲
Western
Area Stop

●
Central
Area Stop

■
Eastern
Area Stops

FIGURE 15
Peak Hour Government Center Shuttle Routes



South Station shuttles serving the eastern area will turn east on Northern Avenue from the SAR Exit Road. They will stop once opposite Commonwealth Pier (under the viaduct), and once again immediately past D Street. They will return to the SAR via a ramp located near the intersection of Northern Avenue and Harbor Street.

Shuttles to Government Center will cross the Relocated Northern Avenue Bridge and turn right on Atlantic Avenue. They will stop at Aquarium Station and then proceed west on State and Court Streets to the Government Center MBTA station. From there, they will continue via Cambridge Street and Sudbury Street to the Haymarket shuttle stop at the corner of Sudbury and Congress Streets. Next, they will travel down Congress Street across Atlantic Avenue.

It should be noted that the Aquarium shuttle stop is primarily to allow shuttle passengers to transfer to the MBTA Blue Line. Transfers from the Blue Line would be more conveniently made at Government Center. Therefore, shuttles will stop at Aquarium only during the PM peak hour and the off-peak hours. During the AM peak hour, when the demand for transfers to the Blue Line is negligible, the shuttles will turn left from Atlantic Avenue onto State Street and proceed directly to Government Center.

Government Center shuttles returning to the eastern area will turn south on Dorchester Avenue, east on Summer Street, north on Viaduct, east on Ramp Street, north on D Street, and west on Northern Avenue to complete the loop. They will make two stops: on D Street at Commonwealth Flats, and on the north side of Northern Avenue between the Fish Pier and Commonwealth Pier.

Government Center shuttles serving the western area will follow Congress Street across the Fort Point Channel, turn north on Pittsburgh Street, west on Old Northern Avenue, south on Sleeper Street, and west on the New Northern Avenue Bridge. They will make one stop at the westernmost Fan Pier parcel, where a sheltered waiting area will be provided.

Government Center shuttles serving the central area will stay on Congress Street all the way to the SAR Exit Road. They will then proceed north to Pier 4, west on Old Northern Avenue, south on Sleeper Street and west on the New Northern Avenue Bridge. They will have one stop at the west half of the Pier 4 parcel on Old Northern Avenue, where a sheltered waiting area will be provided.

Cycle Times

Route cycle times are one determinant of fleet size, and hence the cost, of any fixed-route service. Cycle time has three components: round-trip travel time, dwell time at stops for boarding and alighting, and slack time, which is the padding built into the schedule to ensure reliable service despite variable travel and dwell times and traffic conditions.

Because reliability is critical to the success of the shuttle system, generous allowances were made for cycle times. Two minutes were allowed for dwell time at each stop. Round trip travel times were based on actual peak-hour runs on Atlantic Avenue, State Street, and Congress Street. To be conservative, the maximum observed travel time rather than the average time was used in the calculations. Additional travel time was allowed to account for future growth in traffic volumes. The 1995 Full Build volume capacity analysis completed for the study area intersections included shuttle bus volumes and their effects on operating conditions. Where appropriate, delays were calculated for congested intersections and added to travel times. Despite the use of maximum travel time, which arguably obviates the need for slack time, a ten percent additional slack time allowance was made on the Government Center shuttles. Since the South Station shuttles will operate mainly on roads which have not yet been built, and therefore cannot be sampled for travel time, conservative assumptions about travel speed were used. For example, 30 mph was projected for the HOV lanes on the Seaport Access Road.

Ridership Levels and Required Frequency

The shuttle system and suburban express bus system (discussed later) will together have adequate capacity to carry all the transit demand from the Fan Pier and Pier 4 Projects, and the other assumed background developments. No demand reduction was made for walking trips or ferry boat trips. During peak hours, when the suburban express buses are operating in South Boston, the Government Center shuttles will have sufficient capacity to serve passengers using the Green, Blue and Orange Lines, Haymarket express buses, and North Station commuter trains. The South Station shuttles will have enough capacity to carry passengers using the Red Line, South Station commuter rail lines, and express buses in the South Station area which serve suburban locations not likely to support direct service into the Northern Avenue area. Of the total peak-hour peak direction transit demand for the proposed projects and four nearby

background developments, 13 percent is projected to use the suburban express bus system, 34 percent is expected to use the South Station shuttles, and 53 percent is forecast to use the Government Center shuttles. These percentages are based on the 1982 Cordon Count for Downtown Boston.

The MBTA assumes 60 passengers per bus to plan peak hour service; however, the proposed shuttle system uses 54 (and a range of 50 to 58) passengers per bus in order to provide an extra degree of comfort and to reduce the potential for excessive dwell times caused by boarding delays. This results in the need for slightly more frequent service than would result from the MBTA planning standard.

Peak-hour route frequencies and fleet size requirements are derived in Table 37. The second column shows the expected number of peak-hour, peak-direction passenger trips using each shuttle route. Dividing each of these volumes by the target busload of 54 passengers provides an approximation of the number of vehicle trips needed per hour. Dividing 60 minutes by the number of required trips gives the approximate headway in minutes. The headway is then rounded off to the nearest whole minute above five minutes, or the nearest half-minute below five minutes. Typical headways in the PM peak hour are three minutes for the western area, four minutes for the central area, and six minutes for the eastern area. The number of vehicle trips required per hour is then adjusted to reflect the rounded headway value, after which the average passenger load is calculated.

Off-peak ridership is estimated as follows. The total bi-directional daily transit demand would be confined to 13 hours per weekday. (To the extent that demand falls outside that time period, some off-peak shuttle capacity will be unutilized.) Next, the total off-peak bi-directional transit demand was obtained by subtracting the bi-directional volumes of both peak hours. This figure is divided by 11, the number of off-peak hours, to arrive at an average hourly bi-directional demand, and the result is divided by two to very roughly estimate the volume in each direction. In the absence of any data to the contrary, it is also necessary to assume that during off-peak hours, when no suburban express buses would be serving the Northern Avenue area, the demand for the South Station shuttle and the Government Center shuttle would be equal. Finally, because these last two assumptions lead to an under-estimation of the needed off-peak capacity, the resultant demand estimate was increased by 20 percent to be conservative.

TABLE 37
Peak Hour Shuttle System Summary*

Route	Estimated Passenger Trips	Required Vehicle Trips	Headway in Minutes**	Average Passenger Load***	Cycle Time (minutes)	Cycle Time Divided by Headway****	Buses Needed
AM PEAK HOUR							
West Area							
From South Station	842	15.0	4.0	56	16	4.0	4
From Government Center	1,297	24.0	2.5	54	25	10.0	10
Central Area							
From South Station	623	12.0	5.0	52	14	2.8	3
From Government Center	959	17.0	3.5	56	28	8.0	8
East Area							
From South Station	471	8.5	7.0	55	17	2.4	3
From Government Center	724	13.0	4.5	56	30	6.7	7
AM Total	4,916						35
PM PEAK HOUR							
West Area							
To South Station	898	17.0	3.5	53	16	4.6	5
To Government Center	1,382	24.0	2.5	58	35	14.0	14
Central Area							
To South Station	646	12.0	5.0	54	14	2.8	3
To Government Center	994	20.0	3.0	50	38	12.7	13
East Area							
To South Station	449	8.5	7.0	53	17	2.4	3
To Government Center	691	12.0	5.0	58	40	8.0	8
PM Total	5,060						46

TOTAL BUS TRIPS PER HOUR	AM	PM
South Station	35.5	37.5
Government Center	54.0	56.0

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* South Station buses on Seaport Access Road; Government Center buses on city streets.

** 60 minutes divided by required vehicle trips.

*** Passenger trips divided by required vehicle trips.

**** Cycle time divided by headway in minutes.

Using these demand estimates, frequencies and vehicle requirements are calculated for the off-peak period. In 1995, the western area has enough demand to require 10-minute off-peak headways, the central area can justify only 20-minute headways, and the eastern area can only support 30-minute headways during off-peak hours. Therefore, the central and eastern areas were combined to form a single off-peak South Station route and a single Government Center route, each of which can support 10-minute headways. The frequencies and fleet size calculations for the off-peak period are presented in Table 38, and the routings for the combined routes are shown in Figures 16 and 17.

Fleet Size Requirements

The number of buses needed is equal to the cycle time divided by the headway, rounded up to the next whole number. As shown in Tables 37 and 38, the shuttle system requires 35 buses in the AM peak hour, 46 buses in the PM peak hour, and 11 buses during the off-peak period.

Cost

Based on information from two bus operators (Medical Area Services Corporation and Hudson Bus Lines), the shuttle service operated under contract by a private provider would cost about $2.7 million annually in 1986 dollars. This cost is based on 250 service days per year, and includes capital, operating, maintenance, and administrative expenses, except for fare-collection costs. It is proposed that shuttle fares be collected at curbside rather than on board. The unit costs are $37 per vehicle-hour, with a 2.5 hour minimum each time a vehicle is used.

Of this annual cost (which is based on service levels for estimated 1995 development), about $1.7 million is likely to be attributable to the Fan pier and Pier 4 Developments, and about $1.0 million to the four background developments. The apportionment is done separately for peak and off-peak periods and is based on peak-direction ridership during each period.

Temporary Pre-SAR South Station Routes

The shuttle buses are proposed to begin operation before 1995, since some of the proposed Fan Pier and Pier 4 buildings will be completed in the earlier years. Temporary shuttle routes prior to opening of the Seaport Access Road have been designed to link the projects and other developments to South Station (see Figure 18).

TABLE 38
Off-Peak Shuttle System Summary

Route	Estimated Passenger Trips	Required Vehicle Trips	Headway in Minutes**	Average Passenger Load***	Cycle Time (minutes)	Cycle Time Divided by Headway****	Buses Needed
West Area							
From South Station	314	6	10	52	16	1.6	2
From Government Center	314	6	10	52	30	3.0	3
Central/East Area							
From South Station	272	6	10	45	19	1.9	2
From Government Center	272	6	10	45	38	3.8	4
							11

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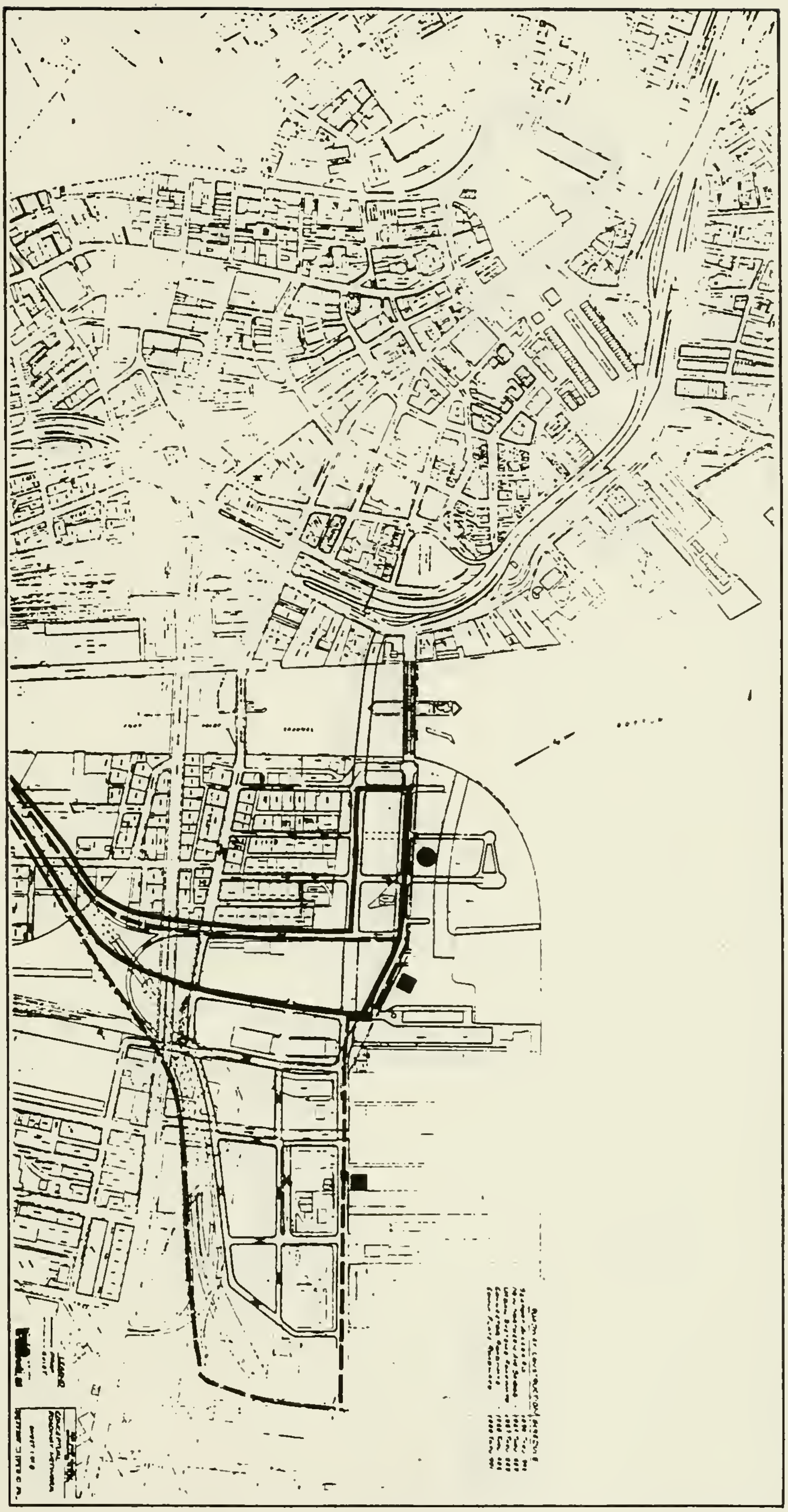
* South Station buses on Seaport Access Road; Government Center buses on city streets.

** 60 minutes divided by required vehicle trips.

*** Passenger trips divided by required vehicle trips.

**** Cycle time divided by headway in minutes.

FIGURE 16
Off-Peak
South Station
Shuttle
Routes



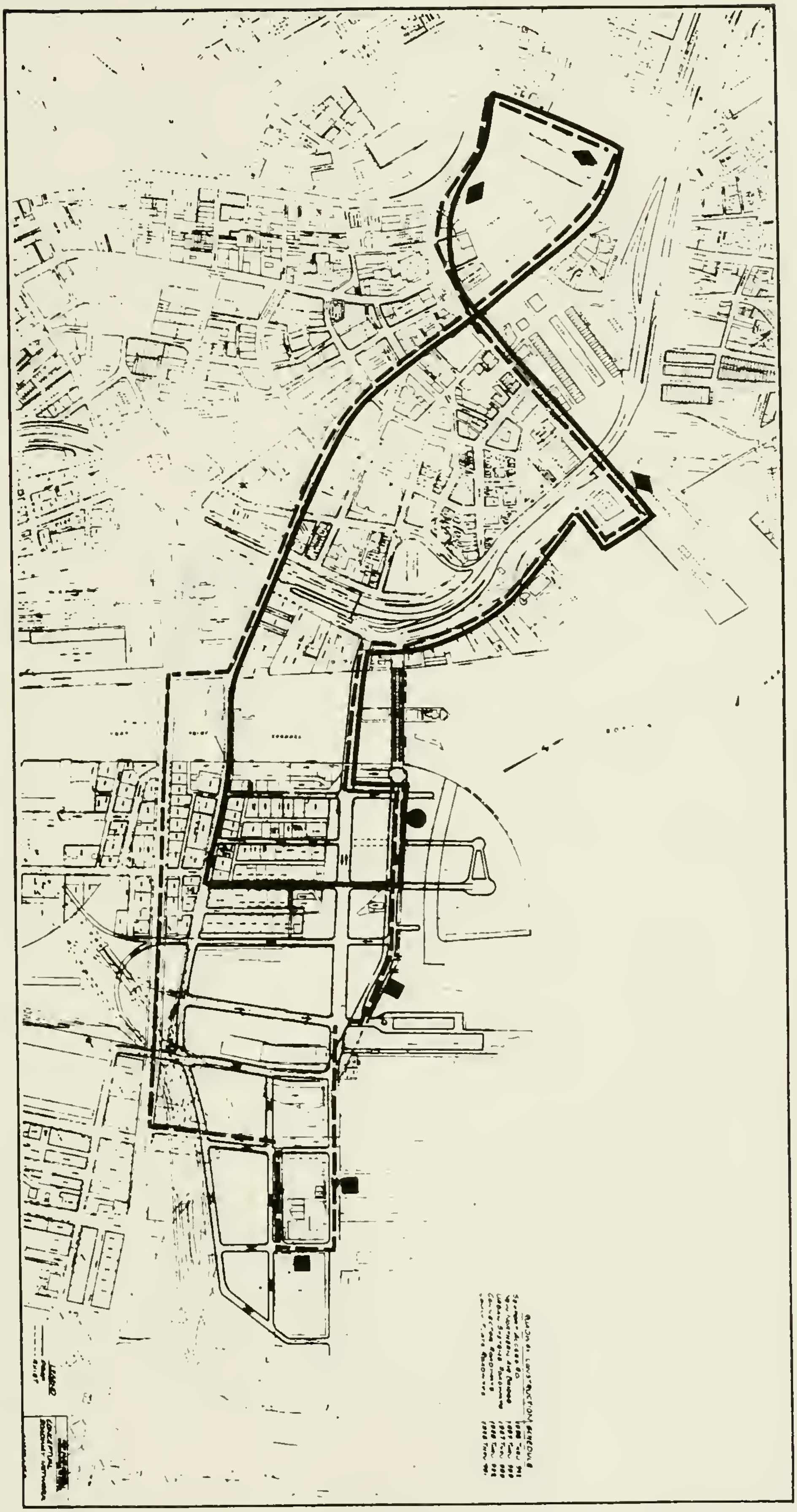
—— Western Area Route

– – – Central Eastern Area Route

● Western Area Stop

■ Central/ Eastern Area Stops

FIGURE 17
Off-Peak Government Center Shuttle Routes



━━━ Western Area Route

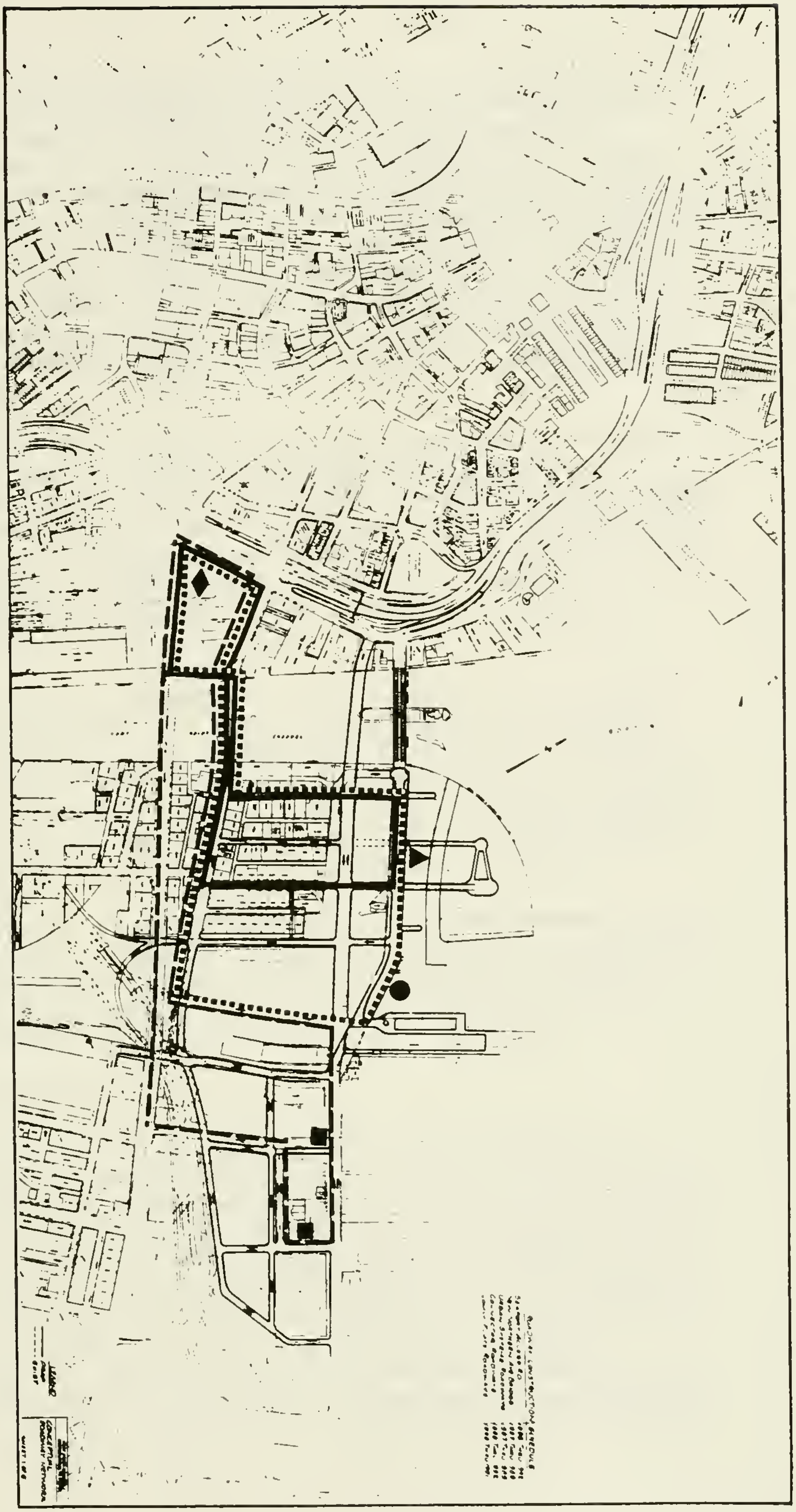
- - - Central/ Eastern Area Route

● Western Area Stop

■ Central/ Eastern Area Stops

◆ Stops Served by Both Routes

FIGURE 18
Temporary South Station Shuttle Routes



▬ Western Area Route

•••••••• Central Area Route

— — — Eastern Area Route

▲ Western Area Stop

● Central Area Stop

■ Eastern Area Stops

◆ Stops Served By All Routes

From the western and central areas, shuttles will travel west on Old Northern Avenue, south on Sleeper Street, west across the Congress Street Bridge, south on Dorchester Avenue, and west on Summer Street. After stopping to discharge and collect passengers on Summer Street, they will turn north on Atlantic Avenue and east on Congress Street. Western area buses will complete the loop by turning north on Sleeper Street and west on Old Northern Avenue, while central area buses will use the advance-construction SAR Exit Road (discussed under New Roadway Capacity below) to return to Old Northern Avenue.

Eastern area shuttles will travel east from Commonwealth Pier and turn right on D Street, stopping at Commonwealth Flats. They will then proceed west on Ramp Street, south on the Viaduct, and west on Summer Street to their stop near South Station. They will return via Atlantic Avenue, Congress Street, the advance-construction SAR Exit Road, and Relocated Northern Avenue.

All shuttle buses will stop on Summer Street opposite South Station in a lane currently used for on-street parking. A separate stop will be set aside for each of the three shuttle routes. The westernmost bus stop will be set back 100 feet from the Atlantic Avenue intersection so that stationary buses will not prevent general traffic from using the curb lane to turn right.

Peak hour frequencies and fleet size requirements are derived in Table 39. Compared to Table 37 for the basic shuttle system presented earlier, the fleet size is nearly identical; one more bus is required in the AM peak hour, and two more in the PM peak hour.

Implementation

The developers have indicated their willingness to provide planning assistance for operation of the shuttle bus system as well as physical on-site improvements to ensure high quality boarding and alighting areas. In accordance with EOTC's philosophy that public transportation be provided by public agencies, the developers will work with the MBTA to ensure that operation of the shuttle bus occurs as soon as the first project buildings are completed. The developers have requested assistance from the MBTA for planning and operating the shuttle bus system. (See letter to MBTA in Appendix.)

TABLE 39
Temporary Shuttle System Summary*

Route	Estimated Passenger Trips	Required Vehicle Trips	Headway in Minutes**	Average Passenger Load***	Cycle Time (minutes)	Cycle Time Divided by Headway****	Buses Needed
AM PEAK HOUR							
West Area							
From South Station	842	15.0	4.0	56	14	3.5	4
From Government Center	1,297	24.0	2.5	54	25	10.0	10
Central Area							
From South Station	623	12.0	5.0	52	17	3.4	4
From Government Center	959	17.0	3.5	56	28	8.0	8
East Area							
From South Station	471	8.5	7.0	55	21	3.0	3
From Government Center	724	13.0	4.5	56	30	6.7	7
AM Total	4,916						36
PM PEAK HOUR							
West Area							
To South Station	898	17.0	3.5	53	16	4.6	5
To Government Center	1,382	24.0	2.5	58	35	14.0	14
Central Area							
To South Station	646	12.0	5.0	54	19	3.8	4
To Government Center	994	20.0	3.0	50	38	12.7	13
East Area							
To South Station	449	8.5	7.0	53	23	3.3	4
To Government Center	691	12.0	5.0	58	40	8.0	8
PM Total	5,060						48

TOTAL BUS TRIPS PER HOUR	AM	PM
South Station	35.5	37.5
Government Center	54.0	56.0

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* All buses on city streets.
** 60 minutes divided by required vehicle trips.
*** Passenger trips divided by required vehicle trips.
**** Cycle time divided by headway in minutes.

Long-Term Alternatives to the Proposed Shuttle Bus System

Several alternative transit links between South Boston and Downtown are being evaluated by other South Boston developers and public agencies. This Access Plan focuses on a shuttle bus system, supplemented by a system of non-stop bus service to suburban locations. A fixed-guideway monorail system is expected to be analyzed in the forthcoming EIR for the World Trade Center's proposed expansion on the Commonwealth Flats. Various rapid transit solutions have also been proposed including the rerouting of some Red Line trains through the development area, or the rerouting of some inbound Blue Line trains to South Station via Logan Airport and South Boston. Exclusive busways are another favored alternative, since they provide a very high ratio of person-carrying capacity to cost and environmental impact. It has been pointed out that the Lincoln Tunnel contra-flow bus lane in New York City carries more peak hour passengers than the MBTA Red Line.

The shuttle bus system is favored by the Fan Pier and Pier 4 developers and is proposed for two reasons: it can carry the projected 1995 (and beyond) transit volumes from Fan Pier and Pier 4 and all assumed background development effectively and efficiently on the 1995 road network, and it can be operational within six months of its selection. More elaborate transit alternatives have other potential advantages in the long run. The long-term buildout of the Northern Avenue area suggests the need to begin planning for transit alternatives with exclusive rights-of-way. In the long term, such systems will provide greater service capacity while freeing up roadways for vehicular use and they will show increasingly attractive cost-benefit ratios.

Recognizing that the best 1995 solution for Northern Avenue area transit is not necessarily the best long-term solution, the developers have agreed to ensure that design decisions they make in the short-run will not preclude construction of a fixed-guideway transit link in the long run. In addition, they have planned the placement of utilities for their sites so as to preserve the potential for a below-grade corridor for exclusive transit use.

Suburban Express Bus System

In the Northern Avenue area, suburban express buses will most likely follow exactly the same route as the South Station/western area shuttles, but they will stop on Old Northern Avenue at the Fan Pier parcel east of

Pittsburgh Street, where a sheltered waiting area exclusively for suburban buses will be provided. The route and stop are shown in Figure 19. This location is very convenient for Fan Pier, Pier 4, and CC&F. It is also within a one-half mile walk of the eastern area developments. However, for the added convenience of passengers going to those eastern area developments, it is suggested that an off-street bus terminal be provided on the east side of the SAR Exit Road just south of Relocated Northern Avenue.

Suburban express buses have successfully captured nearly 20 percent of Downtown transit commuters, most of whom work within a short walk of many transit options. This track record bodes well for their potential to attract commuters who work in the Northern Avenue development area, where they will hold a strong relative advantage over the rapid transit option. Given the excellent highway access via the HOV lanes of the Seaport Access Road, it is likely that MBTA buses traveling non-stop to the Northern Avenue area from Newton Corner or Riverside would attract and retain riders and meet economic performance standards. Likewise, private carrier routes going non-stop to the development area from South Shore points such as the Rockland Park-and-Ride lot could be profitable. Such a route would be even more attractive if the South Boston Bypass Road is opened as an HOV facility as recommended elsewhere in this mitigation section (see New Roadway Capacity below).

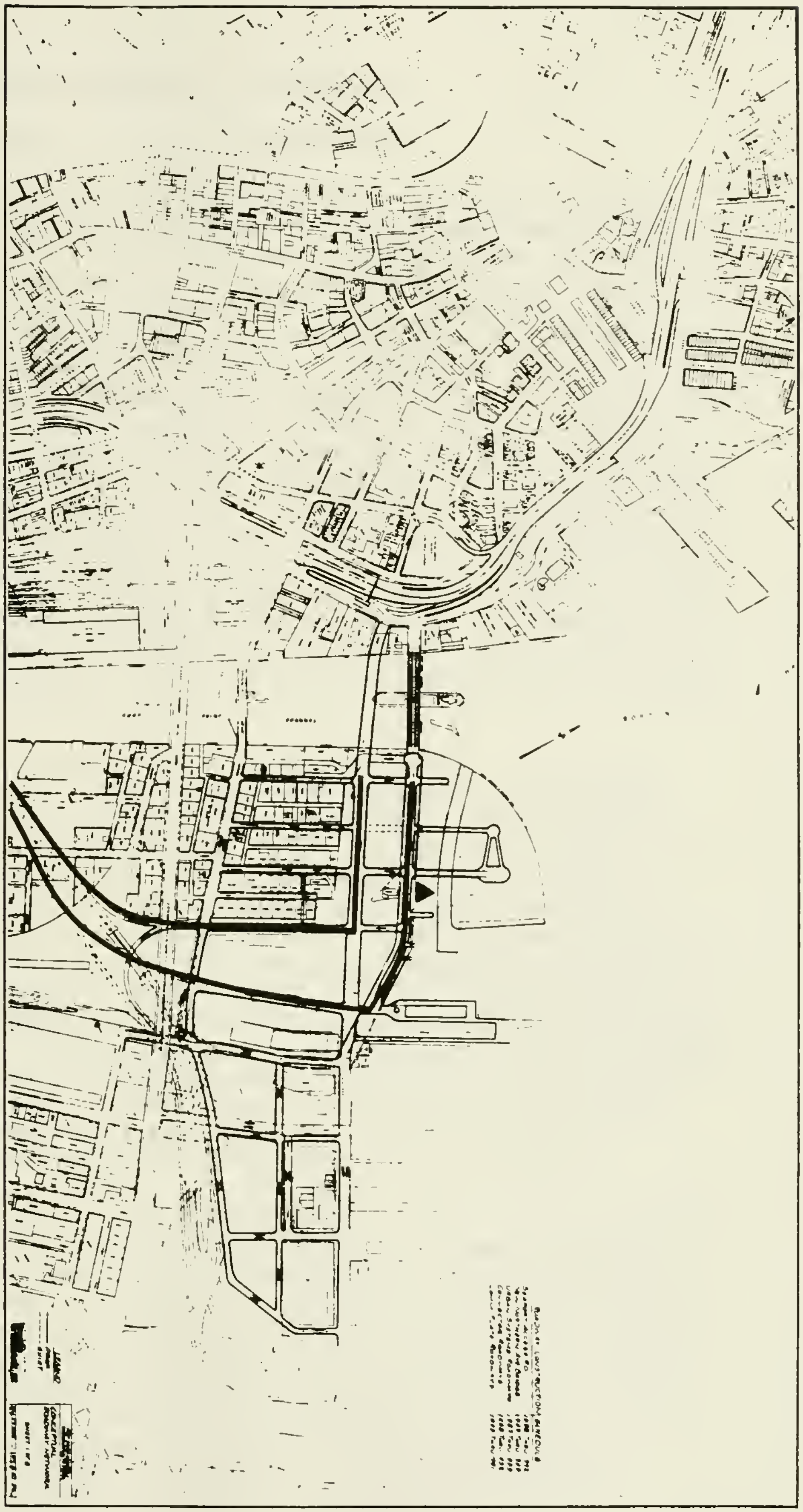
Recognizing, however, that many Downtown express commuter bus routes serve communities too small to support non-stop service to the Northern Avenue area, one cannot expect the express bus mode share in this area to match that observed Downtown. Based on existing ridership figures for the high-potential routes (Rockland, Riverside, and Newton Corner), a conservative estimate of 670 passengers on 15 buses is projected. An additional 80 passengers are projected to commute from the North Shore through the Third Harbor Tunnel on MBTA buses that travel to and from South Station, with a brief stop in the Northern Avenue development area.

The above projections led to the forecast of a 13 percent mode share for express buses, which in turn was used to estimate the capacity needed on the shuttles. However, it should be noted that if the express buses are less successful than forecast, the shuttle system can handle the extra passengers by bringing in additional buses. Likewise, in case the express buses are more successful, the waiting area at the Fan Pier parcel east of Pittsburgh Street can accommodate at least twice the projected number of buses.

FIGURE 19
Suburban
Express
Bus Route

━ Bus Route

▲ Bus Stop



TRAFFIC OPERATIONS IMPROVEMENTS

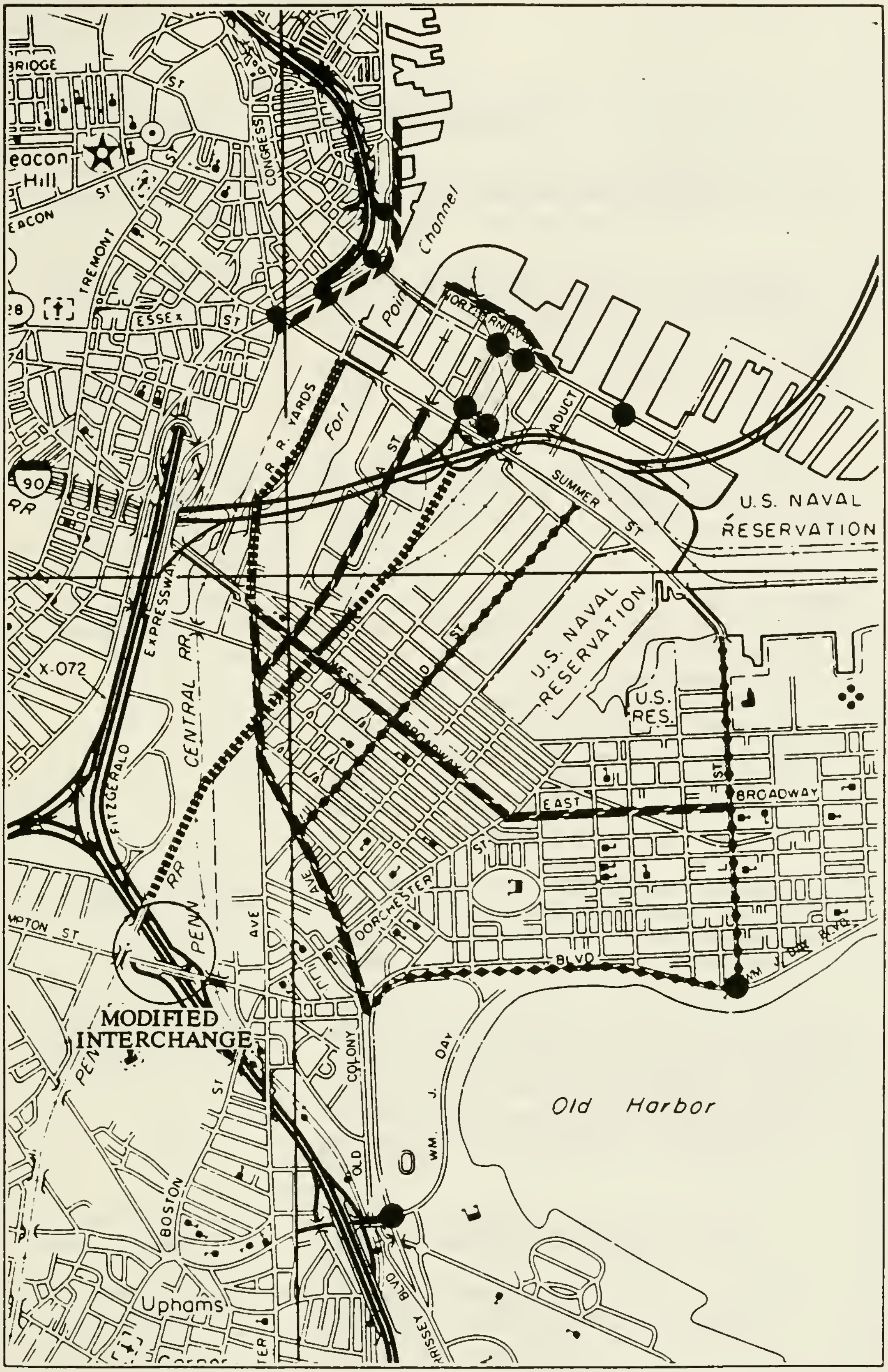
Intersection-Related Improvements

As noted in the Probable Project Impacts section, several analysis locations exhibit capacity deficiencies in the 1995 analysis year. Most of these are shown to be deficient even under 1995 No-Build conditions. The following discussion focuses on traffic operations improvements that are proposed at the 11 locations where Level of Service "E" or "F" conditions (V/C ratios of 0.91 or higher) prevail under 1995 Build conditions in one or both peak hours. Only two of the 11 intersections have deficient levels of service as a result of the projects themselves, four are deficient under No-Build conditions and will be impacted by the projects, and the remaining five are deficient under No-Build but will be affected by the projects only minimally or not at all. This indicates that most of the future traffic growth anticipated in the study area will cause deficiencies whether or not the Fan Pier and Pier 4 Projects are built. Figure 20 shows the 11 locations requiring mitigation.

The types of measures included in this category are basically those that can be implemented relatively easily, quickly, and inexpensively. They attempt to make maximum use of already existing or planned facilities without the need for major reconstruction or redesign. The recommended measures are summarized in Table 40 and discussed below. The implementation of these measures would be the responsibility of the Boston Transportation Department (BTD). The developers have cooperated with the city in providing planning services for intersection improvements as part of the development of this Plan. The program will continue to evolve as part of the South Boston Transportation Study (see below) and will be designed so as to be consistent with known objectives of the South Boston community.

It should be noted that the mitigated volume-to-capacity (V/C) ratios cited in the location summaries below result not only from the specific intersection improvements proposed, but also from the other arterial- and system-type measures noted in later sections. These result in significant traffic diversions from certain routes to others. Therefore, the mitigation analysis involved two steps: computing V/C ratios first with only the traffic diversions from route-related mitigation, then adding the intersection-specific mitigation measures. The V/C ratios presented are the end result of the two-step process.

FIGURE 20
Traffic
Mitigation
Summary



●
Intersection
Mitigation
Locations

▰▰▰
Arterial
Related
Improvements

▮▮▮▮▮▮▮▮
New Roadway
Capacity

◆◆◆◆◆
Traffic-
Restrained
Roadways

TABLE 40
Intersection-Related

Intersection	Mitigation Measures
Relocated Northern Avenue/Seaport Access Road Entrance	Parking restriction on Relocated Northern Avenue westbound in the PM peak; two left-turn lanes into entrance road.
Relocated Northern Avenue/Seaport Access Road Exit	Fourth lane on exit road for right-turn only parking restriction on Relocated Northern Avenue westbound in the PM peak.
Congress Street/ Seaport Access Road Entrance	Third lane eastbound on Congress Street for right turn only.
Congress Street/ Seaport Access Road Exit Exit.	Third lane northbound on Seaport Access Road Exit for left turn only; channelized free right turn on westbound Seaport Access Road.
Atlantic Avenue/ Summer Street	One-way northbound flow on Atlantic Avenue south of Summer Street; AM and PM peak hour parking restrictions on Atlantic Avenue from Summer Street to State Street (see Arterial-Related Improvements) and on Summer Street westbound from Fort Point Channel to Atlantic Avenue; stripe center lane on Summer Street eastbound approach as shared through/left and modify signal phasing accordingly.
Atlantic Avenue/ Congress Street	AM and PM peak hour parking restrictions on Congress Street westbound from Fort Point Channel to Atlantic Avenue and on Atlantic Avenue from Summer Street to State Street.
Atlantic Avenue/ Relocated Northern Avenue	AM and PM peak hour parking restrictions on Atlantic Avenue from Summer Street to State Street; stripe 100-foot approach on Artery exit ramp for two-lane operation; channelize right-turn onto Relocated Northern Avenue and run concurrent with Artery exit ramp.
Atlantic Avenue/ High Street	No operational improvement feasible; requires Depressed Central Artery.
Northern Avenue/ Ramp Street	Signalization; double left-turn lane from Ramp Street to Northern Avenue.

TABLE 40 (Continued)	Intersection	Mitigation Measures
Intersection-Related	L Street/Day Boulevard	Eliminate commuter traffic by restricting access to Day Boulevard (see Arterial-Related Improvements and South Boston Transportation Study).
	Kosciuszko Circle	Traffic diversion to Southeast Expressway due to South Boston traffic management (see South Boston Transportation Study).

Relocated Northern Avenue/Seaport Access Road Entrance. The 1995 PM peak hour Build V/C ratio would be at 1.21 if no improvements were made. This can be reduced to 0.91 with the addition of a third through lane in the westbound direction (by means of a peak period parking prohibition) and dual left-turn lanes into the Seaport Access Road Entrance.

Relocated Northern Avenue/Seaport Access Road Exit. This location requires a fourth approach lane on the exit road for the heavy right turn movement, and a PM peak hour parking restriction on Relocated Northern Avenue westbound. This would reduce the AM and PM V/C ratios from 0.89 and 0.95, respectively, to 0.84 and 0.67, respectively.

Congress Street/Seaport Access Road Entrance. The deficiency at this location occurs in the PM, with a V/C ratio of 0.94. Improvements can be made by adding a third approach lane eastbound on Congress Street for right-turn only into the Seaport Access Road Entrance. The V/C ratio would decline to 0.89.

Congress Street/Seaport Access Road Exit. The AM peak hour represents this location's problem, with a V/C ratio of 1.10. Mitigation measures include addition of a third lane northbound from the Seaport Access Road Exit to provide an exclusive left turn into Congress Street, and conversion of the right-most lane on the westbound approach to a free-flow right turn by installation of a channelizing island. These changes result in a decline in the V/C ratio to 0.77.

Atlantic Avenue/Summer Street. This location is heavily affected by pedestrian traffic from South Station. Pedestrians utilize about 30 percent of the available green time. It should be noted, however, that due to their location, the Fan Pier and Pier 4 Projects will not add appreciable pedestrian traffic across Atlantic

Avenue from South Station. If there were normal pedestrian traffic volumes at this intersection, it would operate in the acceptable range instead of with a V/C ratio of 1.05 in the AM peak and 1.32 in the PM peak. However, these ratios can be improved with the following measures:

- Atlantic Avenue south of Summer Street is scheduled to be converted to one-way operation northbound. This will allow an additional through lane on the approach to Summer Street.
- To take full advantage of this extra lane, restrict parking on the east side of Atlantic Avenue from Summer Street to State Street during both the AM and PM peak periods (see Arterial-Related Improvements).
- Restrict parking on the westbound side of Summer Street from Dorchester Avenue to Atlantic Avenue to obtain an extra lane for right turns.
- On the Summer Street eastbound approach, stripe the center lane for shared throughs and lefts, and modify the signal phasing accordingly.

These measures would reduce the V/C ratios from those cited above to 0.85 in the AM and 0.89 in the PM. Further improvements will be achieved by providing another subway portal on the northwest corner of the intersection (adjacent to the Trailways terminal) to reduce the number of surface pedestrian crossings. This improvement is currently under construction.

Atlantic Avenue/Congress Street. A prohibition on peak hour parking on both Atlantic Avenue (Summer Street to State Street) and Congress Street (Fort Point Channel to Atlantic Avenue on the westbound side) is required in both the AM and PM peak periods, particularly the former. This measure would reduce the more critical AM V/C ratio from 1.32 to 1.13 by allowing an extra through lane on Atlantic Avenue and an additional lane for right turns on Congress Street. The PM peak hour V/C ratio would decline from 1.11 to 0.94.

Atlantic Avenue/Relocated Northern Avenue. The AM and PM peak hour parking restriction on Atlantic Avenue proposed earlier would tend to help operations at this location (1.32 V/C ratio in the more critical AM peak hour reduced to 0.94, and 1.13 to 0.92 in the PM). In addition, the proposed design should be modified to provide a channelizing island permitting right turns from Atlantic Avenue simultaneous with Artery off-ramp maneuvers to Relocated Northern Avenue. This should be

done in conjunction with striping the Artery exit ramp for two-lane operation for 100 feet on the approach to Atlantic Avenue.

Atlantic Avenue/High Street. Improvements can only be achieved through extensive reconstruction because full use is already made of all available lanes under existing and future analysis scenarios. The full I-90/ I-93 project, specifically the Depressed Central Artery, is required to ameliorate conditions at this location.

Northern Avenue/Ramp Street. This location should be signalized with a double left-turn lane on Ramp Street. The projected operation without signalization indicates that no reserve capacity would be available. However, with signalization, the V/C ratio would be 0.37 in the PM peak.

L Street/Day Boulevard. This location will be improved to LOS "A" with the reduction or elimination of commuter traffic on Day Boulevard and L Street as discussed in a subsequent section. Therefore, no other improvements are proposed for this location.

Kosciuszko Circle. Due to geometric restrictions, no operational improvement is possible. Signalization would only result in increased congestion and delay. However, this location would benefit directly from the traffic management measures discussed in the section on Arterial-Related Improvements, such as elimination of commuter traffic on certain roadways in South Boston. This would cause diversion of some traffic back to the Southeast Expressway resulting in improved operation at Kosciuszko Circle, particularly if the South Boston Bypass Road is built (see the section on New Roadway Capacity below). The level of service would improve from "F" to "D/E" in the critical AM peak hour.

Arterial-Related Improvements

The impact analysis identified several capacity and safety-related deficiencies associated with the morning and evening peak hours along neighborhood streets which have been used as commuter-oriented arterials through South Boston. These existing problems may be remedied, at least in part, by means of the measures which are identified below. It should be noted, however, that since these arterials pass through or near the residential area of South Boston, any measures taken to improve or retard the flow of vehicular traffic on these streets must take into consideration the wishes and concerns of neighborhood residents. These locations and others will be studied in more detail in the city's South Boston

Transportation Study. However, previous meetings and discussions with South Boston residents have indicated a preference for reducing or eliminating commuter traffic on streets which are primarily residential. Therefore, this has been accepted as the objective pending further discussion as the transportation study proceeds. The measures which follow that relate to the South Boston community should be regarded as preliminary proposals. Responsibility for implementation will rest with the BTD. The principal arterial locations requiring mitigation are shown in Figure 20 presented earlier.

L Street, D Street, and Day Boulevard. One of the principal objectives of the South Boston community is the reduction or elimination of commuter traffic along residential or recreational roadways, particularly L Street, D Street, and Day Boulevard. The Metropolitan District Commission (MDC), which has responsibility for Day Boulevard, also has expressed interest in relieving the facility of its commuter traffic. Therefore, it is assumed that means can and will be found (either in the form of physical barriers, one-way street segments, police monitoring, resident stickers, etc.) to take commuters off these streets and force them onto more appropriate commuter-oriented routes. All of these suggestions should be included in detailed studies as part of the South Boston Transportation Study being conducted by the City of Boston. It has been assumed that the routes accepting additional commuter traffic will include Old Colony Avenue, Dorchester Avenue and an upgraded A Street (see below). However, since these streets have limited capacity to accept all of the diverted commuter traffic, it has also been assumed that substantial new capacity should be provided to spread the demand. These capacity improvements are described in the subsequent section on "New Roadway Capacity," and include the South Boston Bypass Road and the reopening of the closed segment of Dorchester Avenue adjacent to the South Boston Postal Annex.

The net effects of restricting commuter traffic from Day Boulevard, L Street, and D Street, and providing new roadway capacity on the South Boston Bypass Road and a new Dorchester Avenue are shown in Figure 21. Changes in roadway volumes are shown for the inbound direction in the morning peak hour and the outbound direction in the evening peak hour The impact of these diversions in terms of level of service and volume-to-capacity ratio is shown in the Mitigation Analysis Summary at the end of this chapter.

During the morning peak hour, 726 commuter trips are diverted from Day Boulevard and L Street, and 227

commuter trips are diverted from D Street. These trips are diverted to the Southeast Expressway north of Columbia Road, Dorchester Avenue, and the South Boston Bypass Road. In addition, the South Boston Bypass Road will attract truck and high occupancy vehicle (HOV) traffic from the Southeast Expressway and from D Street. The net result of these AM peak hour diversions is that the Southeast Expressway will lose 103 trips, Dorchester Avenue will gain 385 trips, A Street will gain 132 trips, and the Bypass Road will gain 539 trips in the peak inbound direction. A total of 1,056 trips is diverted from L Street, D Street, and the Southeast Expressway to A Street, Dorchester Avenue, and the Bypass Road.

In the evening peak hour, similar outbound diversions are shown. L Street would lose 595 commuter trips, D Street would lose 184 commuter trips, and the Southeast Expressway would see a reduction of 238 trips. This diverted traffic would use A Street, Dorchester Avenue, and the Bypass Road. A Street would carry 57 additional trips, Dorchester Avenue would carry 313 additional trips, and the Bypass Road would carry an additional 547 trips in the peak outbound direction. The total diversion in the evening is 917 trips from L Street, D Street and the Southeast Expressway to D Street, Dorchester Avenue, and the Bypass Road.

A Street. A Street will require substantial upgrading if it is to serve as one of the principal alternate routes should L Street, D Street, and Day Boulevard be closed to commuter traffic. Effective improvements would include upgrading the signal equipment at West Broadway, West Fourth Street, and Dorchester Avenue/West Fifth Street and coordinating the signal controllers to permit smoother traffic flow through these closely-spaced intersections. Signal timing should consider the heavy truck traffic along this section of A Street (which is part of the designated truck route through South Boston), but should also include appropriate pedestrian intervals. Consideration should be given to restricting heavy commercial vehicles to non-peak hours to provide more capacity for commuters prior to the availability of the South Boston Bypass Road, which should ultimately serve as an HOV and truck facility when constructed. Repaving the entire length of A Street would also be beneficial, and parking prohibitions should also be instituted throughout, at least during the peak hours. Loading/unloading activity should either be relocated off-street (preferably) or at least prohibited during peak commuter hours (see subsequent section on Areawide Commercial Vehicle Restrictions).

Old Northern and Relocated Northern Avenues. The project developers will continue the on-going public/private sector consultation process. They have developed a design concept for Old Northern Avenue and are providing input for the design of Relocated Northern Avenue. The developers will design and construct streetscape improvements on the north side of Old Northern Avenue, which will include a four-lane cross-section featuring a curb bus lane serving the Fan Pier and Pier 4 Projects and future Cabot, Cabot & Forbes development. The original design included two lanes in each direction between Sleeper Street and the Seaport Access Road (SAR) Entrance Road, with a three-lane, one-way westbound design between the SAR Exit and Entrance Roads. As a mitigation measure, this configuration has been modified to include three lanes westbound (including the bus lane) and one lane eastbound throughout to provide improved traffic flow and better vehicular interchange between the Fan Pier and Pier 4 Projects. The project developers will also provide streetscape improvements, including ample sidewalk elements, and bus stop waiting area locations integrated with facade setbacks, arcades, and weather protection at project buildings.

Relocated Northern Avenue, which is currently being designed by the City, is to include two through lanes in each direction with turn lanes added at key intersections and curb parking on both sides. It is proposed that parking be prohibited in the north side parking lane during the afternoon peak period to obtain a third travel lane westbound. The prohibition would extend from east of the Seaport Access Road Exit to Sleeper Street.

Old Colony Avenue/Dorchester Avenue. The portion of Old Colony Avenue between Columbia Park and Dorchester Avenue should be considered for a parking prohibition during the AM and PM peak periods to allow three-lane operation. The section of Dorchester Avenue between Old Colony Avenue and West Broadway should be regraded and repaved to eliminate the uneven roadway surface in the northbound direction. Consideration should be given to a minor widening on the northbound side to straighten the curve somewhat. Signal timing should be checked for compatibility with traffic flows at all signalized intersections along this route, particularly in the PM peak period.

Atlantic Avenue. Parking is currently permitted along Atlantic Avenue between South Station and State Street. The intersections at Summer Street, Congress Street, and Relocated Northern Avenue will operate at deficient

levels in 1995. All locations would have improved V/C ratios with the restriction of parking and provision of an additional travel lane in the peak hours. In addition, operations between Northern Avenue and State Street would benefit from the provision of an additional travel lane, particularly for the proposed shuttle bus route between the project area and Government Center. As was successfully done by the BTD with Congress Street, all peak hour parking along Atlantic Avenue from Summer Street to State Street should be restricted and an additional travel lane should be provided. State Street is proposed as the northern limit of the parking restriction because it is the location where the shuttle bus would turn off Atlantic Avenue and it has been identified by the city, along with Atlantic Avenue, as a future traffic-management street similar to Congress Street.

East and West Broadway. The major problem along most of this roadway west of L Street is double-parking which severely restricts the flow of traffic and results in congestion, delay, and an unsafe condition. The short-term parking limit along both sides of Broadway should be enforced to free these spaces for additional parkers. Double-parking should be eliminated through strict enforcement.

Designated Truck Route. To alleviate truck traffic through the heart of the South Boston residential area, the city has designated a truck route along mostly commercial/industrial streets between the Southeast Expressway and the industrial areas of South Boston. The route runs along portions of Southampton Street, Dorchester Avenue, A Street, West Broadway, C Street, and First Street (West and East). To encourage the use of this route by commercial vehicles and thereby reduce truck traffic through the residential portions of South Boston, the following measures are recommended:

- Additional and clearer signing of the truck route, beginning at the Southeast Expressway.

- Increased enforcement of no-parking restrictions along the route.

- Elimination of on-street truck loading.

- Additional signing along residential streets prohibited to trucks.

- Increased enforcement along no-truck routes.

- Improvement of the West First Street/B Street intersection for truck movements by widening sharp corners and improving the pavement surface.

- Implement the improvements now under design by the MBTA for the West Broadway/Dorchester Avenue intersection.

System-Related Improvements

Certain measures which relate to the entire study area rather than to individual intersections or streets include the following items, responsibility for which will rest with the BTD.

Traffic Signal System Optimization. It has been demonstrated that one of the most effective ways to improve traffic flow on an areawide basis is to improve the traffic signal system. Therefore, a comprehensive analysis of the existing signal system in the South Boston area is recommended. The Boston Transportation Department is in the process of upgrading many of its signals to an advanced computer-based system using real-time detection of actual traffic conditions on selected links. This should include the South Boston subarea. The upgraded system can be analyzed for signal timing effectiveness using a computer model such as TRANSYT-7F. Such improvements have been shown to improve speed and travel time by 8 to 12 percent.

Such an analysis may show that a reallocation of green time at certain locations is possible within the context of overall network control. Strategic shifts of current (or future) underutilized green time would further optimize vehicle flow and reduce queue lengths and congestion.

Enforcement. With the city's current computerized traffic violation program and more widespread use of towing and the "Denver Boot" by the BTD, the city is stepping up its enforcement of parking regulations. Vigorous enforcement can provide the "extra capacity" that is already built into the roadway system, but which goes unused because of illegal parking. It is proposed that a concentrated effort be continued to insure that more of this capacity is available for peak period use. In particular, elimination of double parking on Broadway, illegal parking activity along the designated truck route, illegal parking in lanes designated for through traffic during peak commuting hours, and unwarranted truck activity on no-truck streets should be given priority. Towing should be a major component of the enforcement effort. The project developers will, if

permitted by the City, tow illegally-parked vehicles on Old Northern Avenue to insure unimpeded operation of the bus lane (see discussion of bus transit in Demand Reduction/Management section below). The project developers must also enforce restrictions dealing with no on-street or peak period deliveries (see Employer-Sponsored Program in Demand Reduction/Management section).

Areawide Commercial Vehicle Restrictions. Actions to reduce vehicle use in congested areas should consider all travel, including goods movement. One significant factor that often contributes to street congestion is delivery/loading activity by commercial vehicles, particularly the larger trucks which utilize South Boston streets. However, restrictions on truck deliveries are particularly difficult to implement because of the large number of vehicle operators involved. The project developers will cooperate with the City in formulating an areawide policy on managing commercial vehicle traffic to reduce peak hour congestion. Various proposals have been made for restricting traffic in peak hours, including time shifts in deliveries, permits, and vehicle size limitations. Much of the discussion involving truck deliveries is based on "Actions to Reduce Vehicle Use in Downtown Areas," John Crain et al., Transportation System Management, Transportation Research Board, Special Report 172, 1977.

Time shifts in delivery schedules may help improve peak hour traffic conditions. One approach is to schedule goods and services traffic before or after the morning rush period. Because the morning rush period is slightly shorter than the afternoon rush period, the morning period generally has more uncongested time available. Many commercial vehicles already make early deliveries, which indicates that restructuring of delivery times has some acceptance. Another approach is to encourage more night deliveries. In some cases, the installation of "night-drop" facilities (analogous to the night mail-drops and bank deposits) can facilitate a shift to night deliveries.

Permits can be issued for commercial vehicles so that only those that need to be in the congested area during the peak period have legal access. Such permit systems may have to be augmented with designated truck routes and appropriate signage to divert non-permit commercial vehicles away from the congested area.

Vehicle-size restrictions can be imposed. Large trucks and commercial vehicles tend to aggravate traffic congestion during peak periods, but smaller vehicles

(such as panel trucks and pickups) have operating characteristics and parking requirements similar to automobiles. Therefore, if the larger vehicles are excluded in specific areas during peak periods, traffic may flow more freely. Again, this could be done in conjunction with the proposed new South Boston Bypass Road discussed in the subsequent section on New Roadway Capacity. Limitations would also be desirable to on-street loading/unloading activity whenever possible.

On-street truck loading currently occurs at many locations in South Boston. These activities block portions of through roadways, encouraging truck drivers to use alternate routes (including residential streets) to avoid the congestion caused by the unloading activities. This can be alleviated by encouraging private warehouses to relocate their loading docks to off-street locations. This effort should be undertaken both on and off the designated truck route to eventually eliminate all on-street loading.

It is recommended that the BTD work with employers in South Boston to encourage implementation of these measures, and that appropriate zoning changes be implemented as required to allow off-street loading facilities.

South Boston Transportation Study

This project-specific Transportation Access Plan cannot resolve the larger and long-standing transportation planning issues of the South Boston area and nearby regional transportation facilities. However, it is recognized that the South Boston community has legitimate concerns about traffic flow and pedestrian safety throughout the neighborhood. The City has retained a traffic consultant to develop a South Boston Transportation Program. The first phase of the program is the reconsideration of truck routes through South Boston with implementation of any changes anticipated in spring of 1987. The second phase will develop a vehicle circulation plan with implementation scheduled for October 1987. The final phase addresses traffic signal and intersection improvements which would be implemented from summer 1987 through 1988. The project developers have contributed substantially to the cost of conducting the study and will work with the City and its consultant to assist in implementing the traffic improvements. The Fan Pier and Pier 4 project team will continue to maintain liaison with the City in this effort.

The study should focus attention on the issues of most concern to local residents. Some items recommended for inclusion are:

- Traffic to the Boston Marine Industrial Park (BMIP) via I and K Streets.
- Bypass traffic in general on E and F Streets.
- Bypass traffic on Dorchester Street and Old Harbor Street (around the Dorchester Heights monument).
- The West 7th Street/Dorchester Street feeder routes.
- Illegal parking on certain streets due to the influence of the BMIP, the Barnes Building, and other facilities.
- The effect of commercial truck traffic on neighborhood streets.
- Better access to the area south of Northern Avenue for the commercial establishments in that area.
- Approaches to promoting pedestrian safety in general and along commuter routes in particular, including such measures as painting crosswalks at intersections, provision of crossing intervals at traffic signals with pedestrian-actuated pushbuttons, and prohibition of parking near intersections to improve visibility.
- Work with the MDC to consider options for implementing its tentative proposal to prohibit commuter traffic along Day Boulevard.
- Restriction of commuter traffic on L and D Streets.
- Possible changes in traffic circulation in the residential portions of South Boston to discourage commuter and truck traffic.
- Impacts of the reopening of the section of Dorchester Avenue adjacent to the South Boston Postal Annex.

NEW ROADWAY CAPACITY

This section considers options which can provide additional roadway capacity through new construction or the reclamation of previously-built but now underutilized capacity.

Advance Construction of Links to the Seaport Access Road

It would be highly desirable to construct as soon as possible the proposed connections to the Seaport Access Road between Relocated Northern Avenue and Congress Street. This was recommended in the Fan Pier/Pier 4 Draft EIR and now appears to be accepted as a necessary feature of local infrastructure planning. As a result, design of these links should be completed by the Central Artery Team in 1988. Construction is expected to take place during 1990-1992. The project developers will continue to provide planning information to agencies responsible for implementing these facilities.

The construction would involve two one-way roadways running parallel to and between Pittsburgh Street and B Street, as shown earlier in Figure 5. They would complement another one-way pair formed by Sleeper and Pittsburgh Streets. Farnsworth and Stillings Streets would remain as local access streets only. The new links would help to disperse traffic between the project sites and the west via Congress Street and Relocated Northern Avenue, and to the south via Congress, B, Fargo and D Streets as well as Northern Avenue, Ramp, Viaduct, Summer and D Streets. B Street between Congress and Fargo Streets, along with Fargo Street between B and D Streets, should be repaved. These new roadways can eventually be tied into the South Boston Bypass Road described below, but are not dependent on its implementation.

South Boston Bypass Road

In 1980, a study was conducted to determine the feasibility of several options proposed to alleviate truck traffic in South Boston, as well as to improve access to the seaport area ("Preliminary Environmental Assessment, Seaport Access System, South Boston, Massachusetts, "Fay, Spofford & Thorndike, Inc. and Wallace, Floyd, Ellenzweig, Moore, Inc., June 1980). One of the alternatives evaluated was a new roadway linking the Southeast Expressway at the Southampton Street interchange with Summer Street, Congress Street, and Relocated Northern Avenue. Much of the route was proposed to be in the existing railroad cut running parallel to and just west of B Street and passing under Dorchester Avenue and West Seventh through West Second Streets. It was proposed for truck traffic only south of West First Street, primarily because the rail cut is narrow and it would be prohibitively expensive to rebuild all of the bridges to permit more than two-lane operation for general purpose traffic. It is proposed here, however, that the two-lane road be utilized as a

high-occupancy vehicle (HOV) and truck facility. The priority order of use of the available capacity would be buses, trucks, vanpools, taxis, and carpools (three or more occupants). During periods of heavy construction activity related to the many facilities proposed in the South Boston waterfront area, its primary use would be as a facility for construction vehicles.

At the northerly end, the South Boston Bypass Road could tie into the new connections described above for access to Relocated Northern Avenue. It could also be connected to Fargo Street as an alternate route to the Army Base area via Summer Street, although Fargo Street would require repaving. It would provide a direct connection between the Northern Avenue area and the Southeast Expressway and would divert some of the traffic, including the larger commercial vehicles, from South Boston streets, which has been a source of concern to local residents. It would operate as a relief valve for the Southeast Expressway/Seaport Access Road route if congestion builds at the Massachusetts Avenue interchange. It might also serve as an incentive to increase private automobile occupancy if cars with three or more passengers were permitted to use this as a shortcut to the Southeast Expressway beyond the Massachusetts Avenue congestion point. The implementing agency would be the MDPW. The project developers will assist in feasibility planning and estimating costs and benefits of the facility's construction.

Reopening of Dorchester Avenue

As noted earlier, increased vehicle capacity is required to handle commuter traffic diverted from L Street, D Street, and Day Boulevard if those roadways are closed to commuter traffic, in accordance with the objectives of the MDC and the South Boston community. Part of this new capacity can be obtained from reopening the closed portion of Dorchester Avenue now used by the U.S. Postal Service at the South Boston Postal Annex. The roadway is currently under federal jurisdiction. A one-way version of such a facility is planned as part of the I-90/I-93 project, although it would be a new ramp adjacent to the existing roadway. It would be desirable, at least as an interim measure, to operate the reopened roadway as a two-way facility to obtain maximum opportunity for alternative routes to/from South Boston. The two-way scheme can either be retained or converted to the one-way proposal when the I-90/I-93 project is constructed. The U.S. Postal Service would retain sufficient space for its truck loading/unloading activities. This proposal should be investigated further as part of the South Boston Transportation Study.

DEMAND REDUCTION/MANAGEMENT

Employer-Sponsored Program

Reducing the amount of traffic generated and managing it more efficiently are equally effective means to mitigate traffic. Much can be done at the employer level to develop programs in this area and to provide the proper incentives to make them work. To reduce auto use, the Fan Pier and Pier 4 developers will, through their lease requirements, have future tenants introduce and maintain programs which encourage ridesharing as well as use of mass transportation. Programs will include the following:

- Ridesharing-related measures
  - Preferential parking for carpools/vanpools.
  - Participation in a joint carpooling program with other tenants and other area developers and companies.
  - Provision by tenants of carpool/vanpool matching service.
  - Sponsorship of Caravan (an organization which leases commuter vans and provides some administrative organizational help) or other van leasing program.
- Transit-related measures
  - Tenant sales to employees of MBTA passes and private bus line tickets.
  - Provision of space in tenant areas for commuter information on routes, schedules, fares, carpools/vanpools, and pass/ticket programs.
- Other measures
  - For employees who wish to commute via bicycle, provision by the developers of a secure bicycle storage area.
  - Consideration by tenants of a flex-time or staggered work hour system to reduce peak hour traffic impacts.
  - Restriction of tenant delivery vehicles to off-peak periods.

-- All delivery/service activities will take place off-street.

-- Promotional material about the programs in tenant publications.

-- Appointment by tenants of a Transportation Manager to coordinate all of the above efforts.

MBTA Rapid Transit Improvements

To address the projected deficiencies in planning capacity on the Blue and Orange Lines, increased frequencies (i.e., reduced headways) are recommended. On the Blue Line, shortening headways from four minutes to three would increase planning capacity from 6,600 to 8,800 and bring the volume-to-planning-capacity ratio to the ideal of 100 percent. On the Orange Line, the provision of a 3.75-minute average headway as currently provided on the Red Line/South would increase projected Orange Line capacity from 12,400 to 14,880 which would likewise provide sufficient capacity to handle expected ridership.

These recommended mitigation measures would require no physical improvements to either lines' right-of-way. MBTA officials were contacted to confirm that the Blue Line and new Orange Line signals can handle the recommended headways. However, additional rolling stock and operating crews would be required.

Water Shuttle

At the request of the State Interagency Coordinating Committee, the Fan Pier developer has studied the feasibility of a water shuttle which would service prominent waterfront locations such as major transit stations, the Fan Pier and Pier 4 Projects, other developments, and public institutions. Such a water shuttle would improve access between the sites and public transportation nodes, fostering commuter use of mass transit to the Fan Pier and Pier 4. An intermodal water shuttle could provide an enjoyable alternative to land-based transit, particularly at peak hours, and could be used in addition to the previously discussed bus shuttle system. Other groups, such as the EOTC, Boston Harbor Associates, and the Boston Chamber of Commerce, have also been exploring similar types of waterfront transportation systems. The project developers will provide boat landings and other facilities at their projects, coordination and scheduling of services, and marketing/promotional services to attract patronage. Coordination will also include the World Trade Center relative to

commuter boat destinations. The MBTA, BRA, EOTC, Massport, as well as other agencies and developers, are also participating in this program.

Water Taxi Service

Unlike a commuter boat operation which serves long-haul trips, or a scheduled water shuttle, a water taxi service would cater to short on-demand trips around the harbor using smaller craft. The Massachusetts Port Authority has already had a successful experience with its Airport Water Shuttle this year, although this is a scheduled service. A true on-demand water taxi service would be ideal for trips between the Fan Pier and Pier 4 sites and North Station, Charlestown, East Boston (including the airport), and other harborside destinations in Downtown, particularly during peak commuter hours when land connections may be difficult due to traffic congestion. Although difficult to quantify, benefits from a water taxi service would include reduced auto travel in critical areas such as the Fort Point Channel crossings, the Callahan and Sumner Tunnels, and the Mystic River crossings. Such services have been used very successfully in other cities (e.g., Stockholm). Docking facilities would need to be provided by developers and agencies such as the MBTA, BRA, EOTC, MDC, and/or Massport along the waterfront in appropriate locations. The Pier 4 developer is, with the encouragement of the State Interagency Coordinating Committee, planning to implement a water taxi service in conjunction with the initial construction on Pier 4. Results of the early operation will be used to refine and expand the service as ridership increases with successive phases of development.

Hotel Marketing, Information, and Shuttle Service

The Fan Pier and Pier 4 developers will work with project hotel operators and developers of other area projects to reserve blocks of project hotel rooms during major World Trade Center and Boston Design Center exhibits. By locating out-of-town visitors in the Fan Pier and Pier 4 hotels, peak hour vehicular travel across the critical Fort Point Channel crossings could be reduced. The project developers will also manage or provide a shuttle vehicle connecting the projects' hotels with major South Boston and Downtown destinations and Logan Airport, supply up-to-date information to travel agents on the various water or bus services that will be serving the hotels, and disseminate information on all available public transport services at the hotels themselves.

Parking Supply and Management

The limitation of parking supply for the projects to not more than one space per 1,000 square feet of office space, plus appropriate spaces for non-office use, has beneficial impacts on local and regional highways. Additional benefits will be achieved through management by the project developers of the available parking supply by allocating at least 20 percent specifically to non-commuters. This will be done by making them unavailable for use before 9:30 and by employing rate control or other means to discourage all-day use.

Pedestrian Access

Relocation of the Northern Avenue Bridge to the south and the current proposal to eliminate pedestrian access across the existing bridge would add about 500 feet to the walking distance between the sites and destinations such as Aquarium Station on the Blue Line and the commuter boat facilities at Rowes Wharf and Long Wharf. Irrespective of plans to create Harborpark attractions on the existing Northern Avenue bridge, it would be very desirable to retain pedestrian access across the entire span to shorten walking distances to the Downtown area. The project developers will provide public pedestrian ways and spaces integrated with the City's Harborpark concept. Ample sidewalk elements will be provided along Old Northern Avenue, and arcades and facade setbacks will be designed into certain buildings along Old Northern Avenue to provide comfortable, spacious, weather-protected, and attractive bus waiting areas.

Agency Coordination and Liaison

The project developers will continue to maintain liaison with various City and State agencies involved in planning transportation facilities in the region, and to cooperate in advancing feasible ideas and plans, such as:

- Expansion of South Shore commuter boat service.
- Reinstitution of South Shore commuter rail service.
- MBTA transit improvement program.
- Implementation of HOV lanes on the regional highway system.
- Satellite parking facilities around the Boston highway system.

-- Logan Airport terminal facilities in South Boston.

This is in addition to those mitigation measures specifically discussed in this Final EIR. The project developers have committed to implement those measures within their direct control, and to continue working with and assisting other agencies to the extent possible with respect to other measures under the jurisdiction of those agencies. The complexity and magnitude of some of these measures precludes obtaining firm commitments at this time. Also, there are overlapping jurisdictions, which means that a coordination effort will be required among all responsible parties. The project developers are willing to be a continuing part of that effort. In the case of the shuttle bus system, the developers are committed to the actions discussed earlier.

MITIGATION ANALYSIS SUMMARY

As discussed earlier, the mitigation analysis was done in two steps, the first with all traffic diversions in place, the second with additional intersection-specific mitigation actions. Traffic diversions are those occurring along main routes into and out of Boston during the peak commuter hours which would be most affected by the elimination of commuter traffic on L Street, D Street and Day Boulevard, construction of the South Boston Bypass road, and the reopening of Dorchester Avenue. The estimated magnitude of these diversions was described earlier. The following sections summarize the impacts of these diversions, as well as intersection-specific mitigation measures. A concluding section describing the qualitative impacts of the demand-reduction strategies is also presented.

Impacts of Traffic Diversion Mitigation Measures

Table 41, presented previously, shows the estimated changes in LOS and V/C ratio on the 11 intersections identified earlier as having an LOS "E" or "F" condition in either the 1995 Build AM or PM peak hour prior to mitigation. The middle column of data shows the impacts of only the traffic diversions, i.e., without intersection specific measures. Clearly, traffic diversions, particularly in the absence of additional mitigation measures, have beneficial effects for areas from which traffic is diverted and adverse effects in areas to which it is transferred. The locations showing the greatest benefits are as follows:

o Day Boulevard/L Street, from LOS "E" to LOS "A" in both the AM and PM peak hours;

TABLE 41
Summary of Mitigation Program Impacts

	1995 Build Without Mitigation				1985 Build With Traffic Diversions				1995 Build With Full Mitigation			
	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Summer St./ Atlantic Ave.	1.05	F	1.32	F	0.97	E	1.32	F	0.85	D	0.89	D
Northern Ave./ Atlantic Ave.	1.32	F	1.13	F	1.31	F	1.14	F	0.94	E	0.92	E
Congress St./ Atlantic Ave.	1.32	F	1.11	F	1.33	F	1.10	F	1.13	F	0.94	E
High St./ Atlantic Ave.	1.65	F	1.05	F	1.65	F	1.06	F	1.65	F	1.06	F
Northern Ave./ Ramp St.	0	E	0	E	191	D	0	E	0.19	A	0.37	A
Day Boulevard/ L St.	2	E	44	E	801	A	678	A	801	A	678	A
New Northern Ave./SAR Ent.	0.63	B	1.21	F	0.66	B	1.22	F	0.67	B	0.91	D/E
New Northern Ave./SAR Exit	0.89	D	0.95	E	0.97	E	0.97	E	0.84	D	0.67	B
Kosciuszko Cir.	1.17	F	1.01	F	0.90	D/E	1.01	F	0.90	D	1.01	F
Congress St./ SAR Entrance	0.61	B	0.94	E	0.65	B	1.05	F	0.49	A	0.89	D
Congress St./ SAR Exit	1.10	F	0.59	A	1.21	F	0.59	A	0.77	C	0.43	A
Old Colony Ave./D St.	0.68	B	0.86	D	0.78	C	0.99	E	0.57	A	0.66	B

* V/C = volume-to-capacity ratio. Available reserve capacity given for unsignalized intersections.

** LOS = level of service.

- Kosciuszko Circle, from LOS "F" to LOS "D" in the AM peak;
- Northern Avenue/Ramp Street, from LOS "E" to LOS "D" in the AM peak;
- Summer Street/Atlantic Avenue, from LOS "F" to LOS "E" in the AM peak.

Other locations which exhibit adverse impacts in exchange for traffic diversions off South Boston neighborhood streets are as follows:

- Congress Street/SAR Entrance, from LOS "E" to LOS "F" in the PM peak;
- Congress Street/SAR Exit, from LOS "F" with a V/C ratio of 1.10 to LOS "F" with a V/C ratio of 1.21 in the AM peak;
- Relocated Northern Avenue/SAR Exit, from LOS "D" to LOS "E" in the AM peak.

In addition, one other location not on the original list of 11 deficient locations would become deficient in the PM peak hour. This is Old Colony Avenue/D Street, which would go from LOS "D" to LOS "E" and is included at the bottom of Table 41.

The above results are prior to intersection-specific mitigation (summarized below), which was applied to improve original 1995 Build deficiencies as well as any new ones created through traffic diversions. It should be noted that A Street, which would carry some of the diverted traffic, is estimated to operate at acceptable levels of service with the measures suggested under Arterial-Related Improvements.

Impact of Intersection-Specific Mitigation Measures

Table 41 also summarizes the effects of applying the various traffic operational improvements discussed earlier on the LOS and V/C values resulting from the traffic diversions. In all cases where deficiencies were caused by traffic diversions, the suggested improvements would cause operations to fall into the acceptable range. They would also improve LOS values at most other deficient locations to LOS "D" or better, or at least decrease V/C ratios below their values without such mitigation. The locations which have remaining

LOS "E" or "F" conditions after all mitigation measures are applied are as follows:

- Northern Avenue/Atlantic Avenue, although V/C ratios are improved from 1.31 to 0.94 in the AM and from 1.14 to 0.92 in the PM;
- Congress Street/Atlantic Avenue, but with V/C ratios improved from 1.33 to 1.13 in the AM and 1.10 to 0.94 in the PM;
- High Street/Atlantic Avenue, where no operational improvement is feasible short of major redesign or reconstruction (AM V/C ratio = 1.65 and PM V/C ratio = 1.06);
- Kosciuszko Circle, where no operational improvement appears feasible to reduce the PM peak hour V/C ratio below 1.01.

Construction of the Depressed Central Artery would be very beneficial to the operation of many Downtown locations, including the Atlantic Avenue deficiencies noted above. As previously stated, the Probable Project Impacts section analyzed traffic conditions in 1995 at study area intersections with only the Seaport Access Road and Third Harbor Tunnel portions of the I-90/I-93 project. The depression of the Central Artery, which is expected to be completed a few years after 1995, was not included in the highway network. Analysis of the 1995 Build and No-Build conditions expected in Downtown Boston indicates the importance of the Depressed Central Artery in providing relief to users of the City street system. The benefit to these users occurs from realignment and reconstruction of streets paralleling and crossing the Central Artery corridor, resulting in safer and more efficient intersections. This benefit of depressing the Central Artery is often overlooked due to much improved conditions expected for Artery users themselves. As such, the Central Artery project can be considered as a long-term mitigation device for projects located along the Northern Avenue development area.

Effect of Demand Reduction Strategies

Although there are many variable factors that make it impossible to quantify the precise effects of each of the above measures on traffic level of service or V/C ratio, it is clear that ridesharing and a first-rate multi-modal public transportation system, along with appropriate incentives for their use, can improve short-term and long-term traffic conditions. The potential exists for a substantial shift in commuting patterns

from single-occupant private autos to high occupancy vehicles or to other modes. Recent experience with express bus services, commuter rail, water transportation, and even conventional rapid transit indicates that people are willing to use these services. If such services can be improved as proposed, Boston's streets and highways will be able to absorb the travel demands of a growing city and region.

TRANSPORTATION MANAGEMENT ASSOCIATION

In developing land areas, another possible mitigation solution is the establishment of a Transportation Management Association (TMA) whose members will be responsible for monitoring site generated traffic and impact area roadway conditions and reporting the results to the City. The TMA will be responsible for installation and operation of all monitoring equipment necessary for the monitoring program described above. The TMA will collect and record the monitoring data and prepare annual monitoring reports to the City.

In addition to its role as a monitoring organization, the TMA will also function as a vehicle to share information, coordinate activities, and cooperate with the City in defining problems and identifying solutions. As an information sharing entity, it could be responsible for many of the information dissemination activities listed under potential mitigation measures. It could be the agency for informing employers and employees about schedules for public transportation, the advantages of ridesharing, and the value of flexible work hours. As a coordination organization, it could provide or arrange for carpool and vanpool matching services, it could provide for transit pass sales, and it could coordinate the activities of the many varied employers in the area, providing economies of scale and efficiencies that could not be enjoyed by individual employers. Finally, the TMA can focus attention on solutions to area problems by the City and State agencies.

Initially, the TMA will be composed of representatives of the Fan Pier and Pier 4 developments. The TMA, in addition, shall have as its members all owners or lessees of real property located with a Northern Avenue PDA, as specified in the Cooperation Agreement for Planned Development Area No. 23. As the area develops, the Boston Redevelopment Authority (BRA) will exercise its best efforts to have other developers in the area become TMA members. All members will be subject to on-site and off-site traffic goals and traffic mitigation standards. The Association would provide an

organization for those with an interest in the area's transportation system to work together to promote the efficient and effective operation of that system as the area grows.

If the TMA is not established or extended to include all members listed above, or if the TMA ceases to exist, references to members of the TMA shall include all developers and owners who fall within the definition of PDA development and non-PDA development.

CONSTRUCTION IMPACTS AND MITIGATION

EXISTING CONDITIONS

Construction activities and how they are managed is an important element of the Access Plan. In this section of the Access Plan, existing site conditions, their use and potential change during the construction period are discussed. In addition, future conditions including expected changes in land use and transportation infrastructure are presented so that a clear picture is developed of the future transportation environment within which construction activities will take place.

Finally, the construction impact section details the probable transportation impacts during two separate points in time: the time when peak truck activity is anticipated, and the period when the number of construction workers on the site reaches its maximum. Since these two periods do not coincide, two separate analysis of impacts have been presented. Mitigation measures deemed necessary to insure that construction activity creates as little impact as possible are also discussed in this section.

A detailed discussion of the existing transportation infrastructure has been provided in the main body and Appendix of the Access Plan. In the construction section, some brief highlights of conditions that impact construction activities are discussed.

The construction site for Fan Pier is currently occupied by a large commuter parking area. The lot is well used since, by parking at the Fan Pier instead of downtown, a commuter can save about six dollars a day.

The provision of 1,500 public parking spaces at the Fan Pier contributes significantly to through traffic in the South Boston neighborhood. The Pier 4 construction site is occupied by Anthony's Pier 4 restaurant. It is a major commercial activity in the development area, but its peak traffic generating periods do not coincide with major commuter travel times.

Trucks are also a significant portion of existing traffic since the Northern Avenue development area is largely industrial. At the intersection of Northern Avenue and Ramp Street and the Fish Pier, trucks comprise 17 percent of all vehicles in the AM peak hour. On the Northern Avenue Bridge westbound, trucks represent 18 percent of the three-hour AM volume.

Truck traffic in the project area is affected by existing limitations on the Fort Point Channel

crossings. The Dorchester Avenue crossing has been closed for many years, although there are efforts now to reopen it. A major proposed crossing, the Seaport Access Road, will not be available before 1994. The Congress Street and Summer Street Bridges are in need of repair, and the Northern Avenue Bridge is slated for replacement in 1989. Current weight limits on the three bridges are displayed below:

	2-Axle	3-Axle	4+ Axle
Northern Avenue	9 tons	12 tons	19 tons
Congress Street	14 tons	20 tons	29 tons
Summer Street	12 tons	15 tons	19 tons

FUTURE CONDITIONS DURING CONSTRUCTION

Several measures have been proposed to alleviate truck and commuter traffic in the South Boston community. A truck route has been designated and posted, but enforcement remains a problem. Design work to upgrade the Summer Street and Congress Street Bridges is underway, with completion expected before 1991. The New Northern Avenue Bridge will open in 1989, and negotiations to reopen Dorchester Avenue are proceeding.

A more innovative proposal is the proposed South Boston Bypass Road along a Conrail right-of-way. This would carry trucks and buses and high-occupancy automobiles on a below-grade facility. Provision of this roadway would enable the City to close L Street and D Street to through traffic (including commuters and trucks). It would also handle the trucks associated with construction of the I-90/I-93 project.

As discussed in the project construction impacts section, the busiest period for project construction will be early 1989 for trucking activity and early 1990 for worker activity. In early 1989, no significant new roadways will be open, but in early 1990, New Northern Avenue and the New Northern Avenue Bridge will be open, as well as the advance-construction Seaport Access Road connectors. The Seaport Access Road itself will not yet be completed.

In addition to changes in transportation infrastructure expected during the Fan Pier/Pier 4 construction period, land use changes are also expected. The Access Plan appendix contains a complete listing of developments expected to be completed within two time frames: 1990

and 1995. Since peak Fan Pier/Pier 4 construction activity will occur in 1989 and 1990, future traffic conditions in this time frame were projected by assuming all 1990 land use projects were completed in 1989 and 1990. Thus, a conservatively high number was used as a base condition for estimating construction traffic impacts.

One of the most significant future conditions impacting traffic flow during Fan Pier/Pier 4 construction results from closing the public parking lot at the Fan Pier before 1989. This will reduce traffic in the development area, because it is assumed that the City will not grant new permits for public parking in that area.

PROBABLE PROJECT CONSTRUCTION IMPACTS

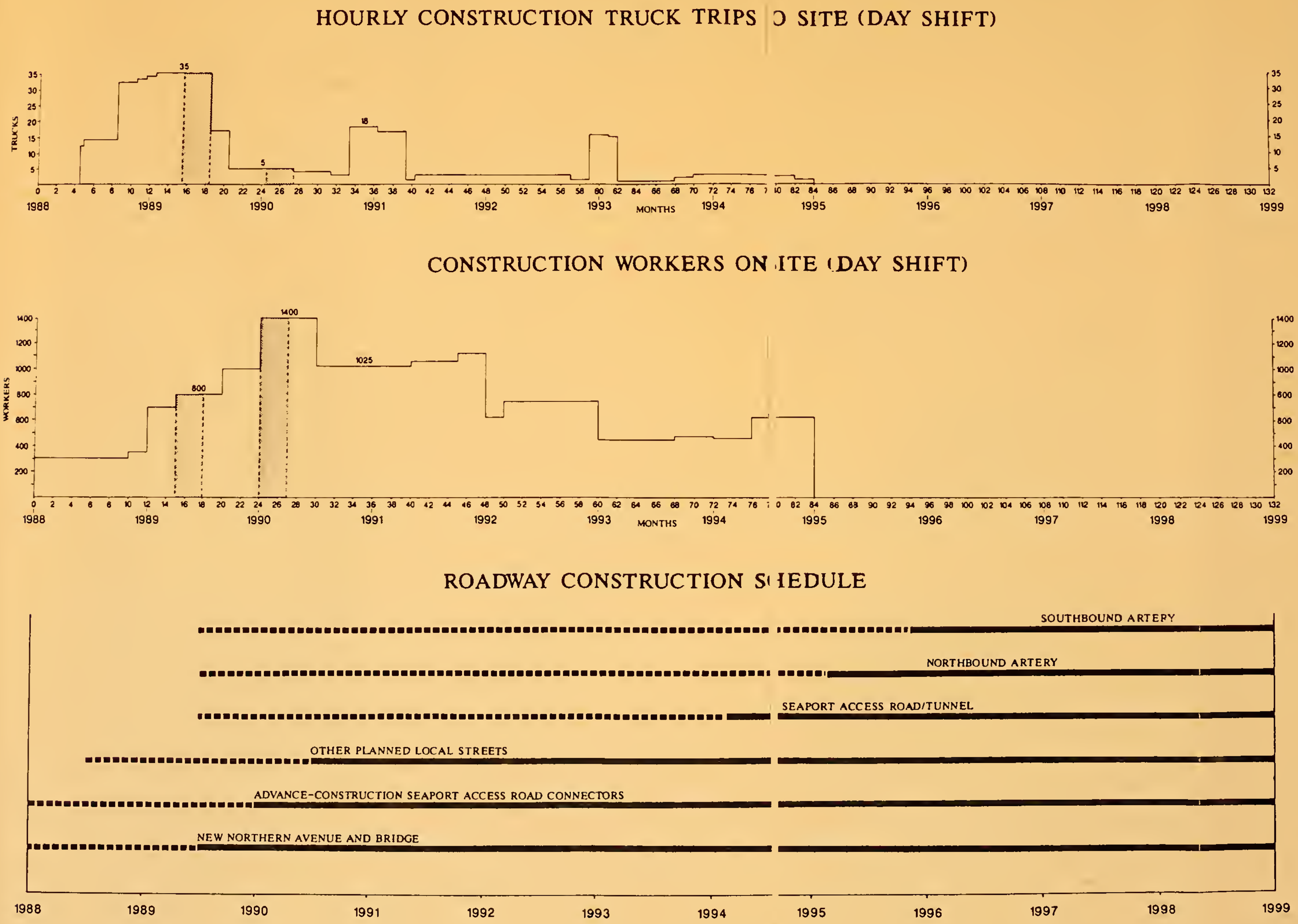
Construction activities which create impacts on the transportation systems serving Fan Pier/Pier 4 are: removal of excavated material; delivery of building materials; and commuting trips of construction workers. Each of these activities will be discussed in a separate section. The entire construction impact analysis has been prepared based upon scheduled activities estimated by construction managers for both Fan Pier and Pier 4. The developments have been considered as a single construction project, and impacts are reported accordingly.

Construction Schedule

The projected start date for construction is late 1987. For simplicity, January 1, 1988 was used as an approximation for the start date. Figure 22 displays the proposed construction schedule for the combined projects as well as implementation schedule for the area road improvements. As shown in the figure, the busiest period for construction truck activity will be in early 1989. The area roadway infrastructure work will be completed in 1989-1990. The busiest period in terms of construction workers will occur in early 1990, when, for six months, about 1,400 workers will be on the job. Since the peak truck activity period and the peak worker activity period do not coincide, they are both analyzed for traffic impacts. Relatively little construction truck activity will occur after 1990, because the buildings on Fan Pier Parcels A, D, F and I, and much of Pier 4, will be complete by that time.

The project infrastructure work has been scheduled so that roadway capacity will not be reduced by on-street activity. Four travel lanes will be continued as

Construction and Roadway Improvements Schedule



HOURLY CONSTRUCTION TRUCK TRIPS O SITE (DAY SHIFT)

CONSTRUCTION WORKERS ON ITE (DAY SHIFT)

ROADWAY CONSTRUCTION S IEDULE

LEGEND:
- ▬ ▬ ▬ Under Construction
- ▬▬▬ Open to Traffic

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Fig. 22

currently provided on existing Northern Avenue until the New Northern Avenue and Northern Avenue Bridge are opened to traffic. At that time, utility work will reduce the number of travel lanes on Old Northern Avenue to two, which will be adequate since Old Northern Avenue will be used only for construction related traffic. Old Northern Avenue will again become a four-lane road before the first project building opens.

Construction Truck Activity

Total excavation for the two projects is estimated at one million cubic yards. Excavation will occur during 28 months spread over more than five years, but the busiest period for excavation will be from Month 9 through Month 18, when approximately 675,000 cubic yards will be removed, at a rate of about 68,000 cubic yards per month, or about 3,200 cubic yards per working day.

At the present time, the proponents believe removal of excavate can best be handled through trucks. Preliminary feasibility studies show that excavate removal via rail and/or ocean-going barges is uneconomical and that barges cannot access the basin between Fan Pier and Pier 4. Nevertheless, the proponent is continuing to investigate waterborne methods for excavate removal. Should waterborne facilities appear through these studies to be economically attractive, they will be utilized. Accordingly, this analysis is based upon a worst-case land impact assumption that all excavate is removed by trucks.

In order to estimate the number of truck loads of excavate leaving the construction site, a conservative estimate of 10 cubic yards per truck was used. This load can be carried over the Congress Street Bridge under existing conditions. To mitigate the traffic impacts of trucks carrying excavate, some excavation activities will be extended into the evening. Therefore, the maximum outbound truck flow for excavate will be about 30 trucks per hour between 7:00 AM and 3:30 PM and about 12 between 3:30 PM and 11:00 PM.

Compared with the busiest 10-month period discussed above, the other 18 months of excavation will be relatively quiet. During Months 5-8 and Months 19-20, outbound flows will be 12 trucks per hour during the 7:00 AM to 3:30 PM and 3:30 PM to 11:00 PM work shifts. During Months 34-39 and Months 60-62, outbound flows will be 14 to 15 trucks per hour during the 7:00 AM to 3:30 PM shift, but no evening shift will be required.

The most likely destinations for excavate are the Lynn area to the north and the Quincy area to the south. Because it is too early to determine the excavate destinations with certainty, truck routes have been planned and designated to both areas. The impact analysis has assumed use of the Congress Street Bridge for all truck routes, even though the New Northern Avenue Bridge will be available for later construction phases. Figures 23 and 24 show recommended truck routes for trips to and from the sites.

As shown in Figure 24, loaded trucks with excavate will all follow B Street (instead of Sleeper Street) to Congress Street in order to avoid having to make a turn near the residential building at the corner of Sleeper and Congress Streets. (Turning trucks make more noise because of the deceleration and acceleration required.) Northbound trucks (if any) will use the Congress Street northbound on-ramp to the Central Artery and Tobin Bridge. Southbound trucks (if any) will follow Dorchester Avenue to Summer Street to the Surface Artery to the Kneeland Street southbound Expressway on-ramp.

Over 80 months of the entire seven-year period of the Fan Pier/Pier 4 construction, some 230,000 cubic yards of concrete and about 35,000 tons of steel will be delivered to the site. Because delivery activity is spread over an 80-month period, the impacts of delivery vehicles on the area street system are much lower than those caused by excavate removal, which occurs over a more compressed time schedule of 28 months. As a result of physical truck capacity and bridge weight limits, concrete is expected to be delivered at the rate of 12 cubic yards per truck, while steel will be limited to 15 tons per truck. With these physical limitations and the dispersed nature of the delivery schedule over a long construction period, the maximum hourly truck flow for materials delivery is only five trucks per hour, and the average over the 80 months is only two trucks per hour.

Construction Worker Activity

The combined project will require about 5,200 labor-years of construction activity. Workers on-site will exceed 1,000 for about two years (1990 and 1991). During the highest six-month period, the first six months of 1990, 1,400 construction workers will be on the site. This period is analyzed for traffic impact. Estimating the traffic impacts of construction workers requires a review of construction worker arrival and departure patterns during the course of a normal work day. Nearly all workers (and absolutely all in the peak

six-month period) will be assigned to the 7:00 AM to 3:30 PM shift. However, overtime will be commonplace during some phases of the project, especially when one or more buildings are nearing completion. Overtime is normally assigned as a two-hour block at the end of a work shift (and occasionally as a four-hour block). This means that workers essentially operate on a 7:00 AM to 5:30 PM shift when overtime is assigned.

Traffic patterns on the local street system as measured during the EIR work show that morning peak volumes occur after 7:00 AM and that afternoon volumes reach consistently high levels between 3:00 PM and 6:00 PM. These traffic conditions and the temporal patterns of construction workers show that the AM peak period is not critical and the PM peak period is the appropriate period for performing significant impact analysis.

Under the most likely scenario, all construction workers depart from the project beginning around 3:30 PM, adding to the PM peak hour traffic volume. For analysis purposes, this volume was added to peak volumes recorded during the 4:30 to 5:30 PM period.

Vehicle-Trips per Worker Trip

According to a construction contractor with experience at similar sites, the project will generate about one vehicle-trip for every two worker trips. This appears reasonable because it suggests, for example, a vehicle occupancy ratio (VOR) of 1.3 and a transit mode share of 35 percent. The same result would occur if the transit share was 45 percent and VOR was only 1.1, or if the transit share was only 25 percent and VOR was 1.5. Given the fact that most workers will have to pay market rates for parking, these assumptions are reasonable. During the peak construction worker activity period (first six months of 1990), some 1,400 workers on-site will therefore generate 700 auto trips from the site in the PM peak period.

Parking Supply

For much of the construction period, parking will not be available on-site. Workers will have to pay for parking, either on the "McCourt" parcel or on the lot across from Commonwealth Pier. The "McCourt" lot is now nearly full, so workers who park there will displace the office workers now parking there who arrive after 7:00 AM. In view of stated City policy to limit licensing of surface parking spaces in the Northern Avenue development area, some of these displaced parkers may shift to transit, while others may shift to downtown garages, displacing

others and forcing some of those parkers to transit. Thus, if the number of parking spaces does not increase, the net additional parkers will be less than the full number of construction worker vehicles. However, to be conservative, the full number of 700 worker auto trips has been used in the level of service analysis.

TRAVEL DEMANDS

Two years were analyzed in the level of service calculations: 1989 and 1990. 1989 was chosen because it represents the peak period of truck activity, and 1990 because it represents the peak period of construction worker activity. Table 42 shows the peak hour demands associated with each construction design year. The travel demands shown are added to the base 1990 network volumes as discussed in a later section to arrive at analysis volumes.

TABLE 42
PM Peak Hour Construction Vehicle Volumes

		1989	1990
Trucks:	Excavate	30	0
	Delivery	5	5
	Total	35	5
	Subtotal Equivalent Autos*	70	10
Autos:	By Construction Workers	400	700
Total Auto Equivalents		470	710

* Assumes that the traffic impact of one truck is equivalent to the impact of two passenger cars.

Peak Truck Activity (1989)

The peak truck activity period uses a combination of excavate removal trucks and delivery vehicles to estimate changes in street operating conditions. Impacts were calculated at two intersections: Congress Street/ Atlantic Avenue and Summer Street/Atlantic Avenue. The impacts were calculated for two cases: first of all, assuming that all truck origins and destinations were north of downtown; and secondly, assuming that all truck origins and destinations were south or west of downtown.

Construction workers were assumed to have the same geographic distribution as workers destined to the project. Travel assignments therefore resulted in some worker vehicle flows through the Summer/Atlantic intersection during the peak truck activity period.

Peak Worker Activity (1990)

During this period, truck activity will be small, so the Congress Street/Atlantic Avenue intersection was not analyzed. Summer/Atlantic was analyzed as well as the New Northern Avenue/Atlantic Avenue intersection. Because the Dorchester Avenue Bridge and the South Boston Bypass Road were assumed not to be available, the intersections of Broadway with A, D and L Streets were analyzed.

Base Traffic Networks (1989 and 1990)

Existing traffic volumes on area street systems were adjusted to reflect these following changes:

- Elimination of public parking at the Fan Pier;
- Addition of background development generated traffic forecast for completion by 1990.

No adjustment was made to reflect truck volumes associated with the I-90/I-93 construction during the two time periods analyzed. Since the final design for I-90/I-93 will not be initiated until 1988, no construction information exists at this time. Early planning by the Central Artery team indicates some construction activity will likely be underway in 1989/1990. This activity will probably consist of construction mobilization, site preparation, construction access road preparation, batch plant construction, etc.

Level of Service Analysis

Level of service results are given in Table 43. Volume-to-capacity ratios are reported for existing conditions, a future base year without construction activity, and two future construction years with construction. As shown in the table, there is no significant difference at any analysis location between the No-Construction period and Construction conditions in 1989 or 1990.

MITIGATION MEASURES

As noted in the construction impacts analysis above, there is no significant impact from construction activities at the project sites in 1989 and 1990. Furthermore, if the City channelizes and signalizes the New Northern Avenue/Atlantic Avenue intersection, and imposes PM peak hour parking restrictions on Atlantic Avenue, Summer Street and Congress Street, as recommended as a mitigation effort in the Impact Assessment,

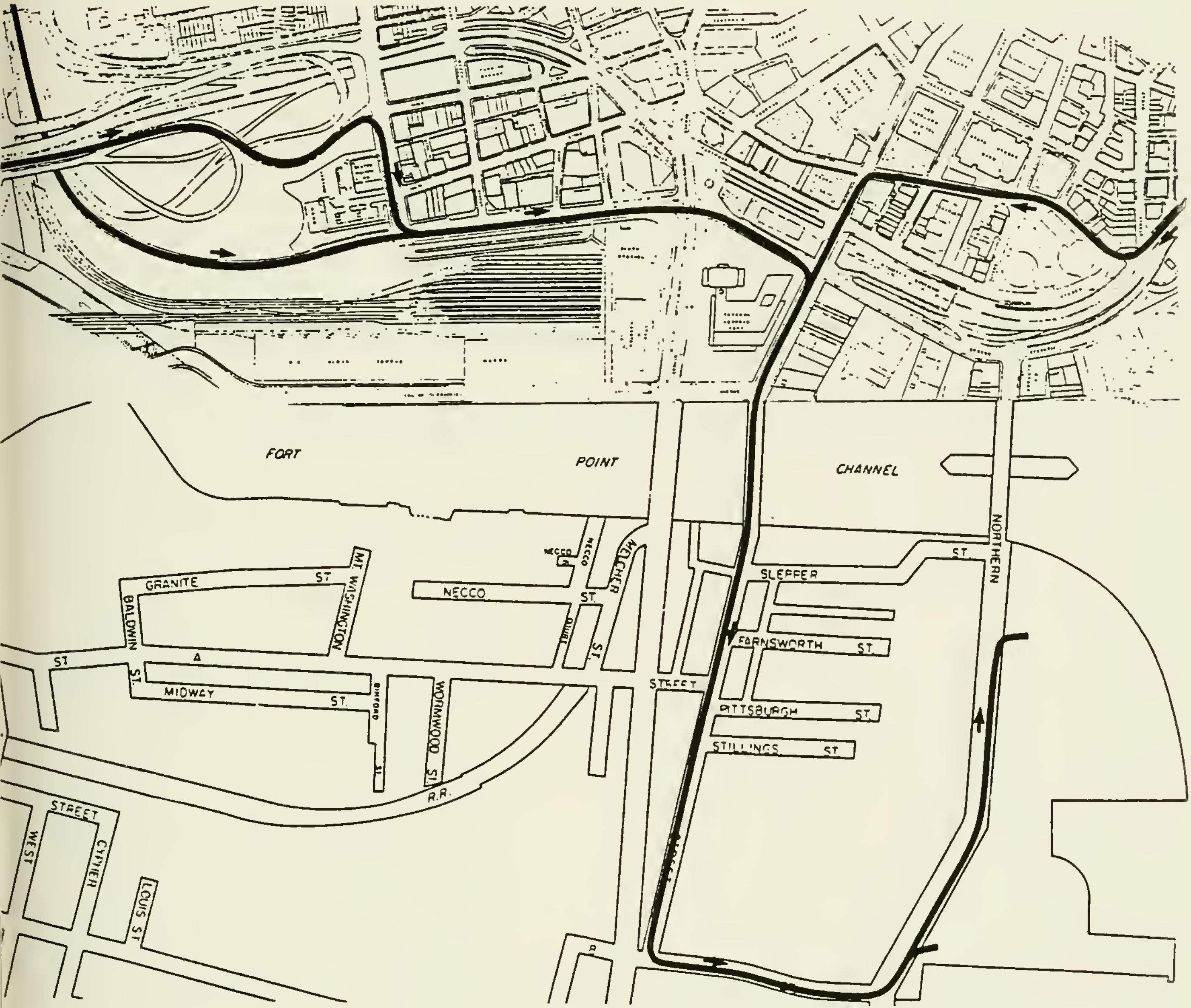
the 1989 and 1990 Construction conditions at the Atlantic Avenue intersections will be better than the No-Construction period conditions without mitigation. Also, with the removal of double parked vehicles at West Broadway and D Street, the City can assure that Level of Service "C" or better is achieved at all the Broadway intersections.

To ensure that the South Boston neighborhood is protected from project construction truck traffic, use of the designated truck routes in Figures 23 and 24 will be required in all construction contracts. The contracts will also allow use of the New Northern Avenue Bridge when it is completed.

Also, as a construction mitigation tool, all contractors working on the site will be required to limit the size of vehicles (subject to bridge load limitations on the proposed truck routes as shown in Figures 23 and 24) being used to remove excavate or bring in construction materials. These vehicle sizes are:

Excavate	10 cubic yards
Concrete	12 cubic yards
Steel	15 tons

In conclusion, construction will not significantly change traffic conditions compared with the projected future year No-Construction situation. This result is partially due to the elimination of public parking at the Fan Pier. Intersection mitigation measures are recommended because they would be beneficial under both No-Construction and Construction conditions. More costly mitigation measures are not needed during the peak periods of construction activity.



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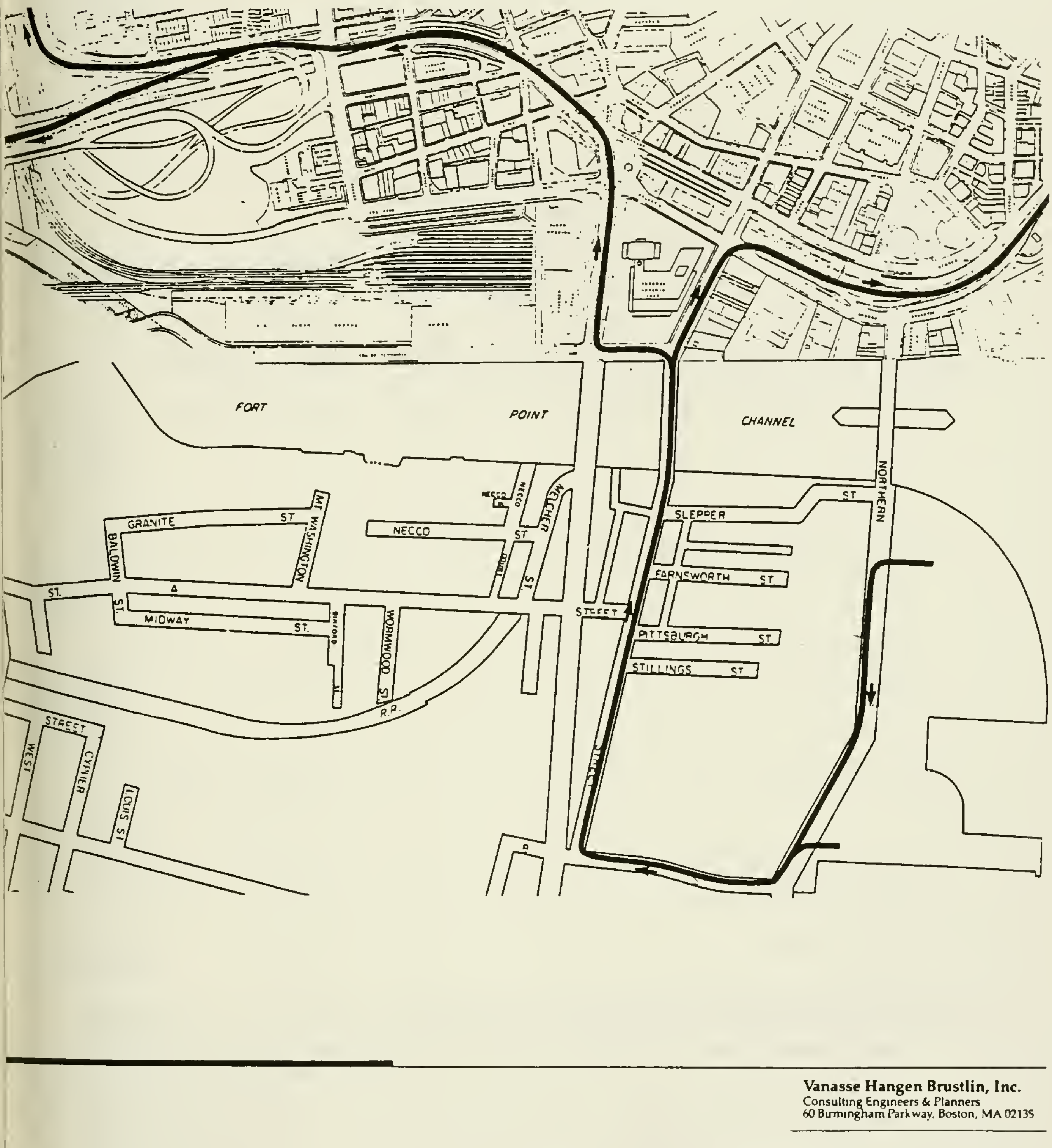
Not to Scale

Truck Routes To Site

Fig. 23



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Not to Scale

Truck Routes
From Site

Fig. 24

TABLE 43
PM Peak Hour Conditions During Construction - 1989 and 1990

					Construction											
					1989 Peak Trucking Activity								1990 Peak Worker Activity			
	Existing		No-Construction Base Year		South/West Unmitigated		South/West Mitigated*		North Unmitigated		North Mitigated*		Unmitigated		Mitigated*	
	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Atlantic Avenue/ Congress Street	0.88	D	0.96	E	0.98	E	0.79	C	0.98	E	0.79	C	NA**		NA	
Atlantic Avenue/ Summer Street	0.94	E	1.10	F	1.16	F	0.86	D	1.10	F	0.79	C	1.12	F	0.81	D
Atlantic Avenue/ Northern Avenue***	0.91	E	1.20	F	+	+	+	+	+	+	+	+	1.23	F	0.98	E
A St./ W.Broadway	0.59	A	0.69	B	+	+	+	+	+	+	+	+	0.74	C	0.74	C
D St./ W.Broadway	0.67	B	0.82	D	+	+	+	+	+	+	+	+	0.84	D	0.70	B
L St./ E. Broadway	0.49	A	0.54	A	+	+	+	+	+	+	+	+	0.55	A	0.55	A

* Intersection treatments were proposed at Atlantic Avenue/Congress Street, Atlantic Avenue/Summer Street, Atlantic Avenue/Northern Avenue, and D Street/West Broadway only.

** NA = not analyzed.

*** Old Northern Avenue for existing conditions, New Northern Avenue for future conditions.

+ No impact due to no truck routings through these intersections.

TRANSPORTATION MONITORING AND MITIGATION

The purpose of the monitoring program is to measure future site generated traffic and future roadway volumes. Monitoring is not limited to site-generated traffic but encompasses demand created by background development as well as the provision of roadway capacity. The site generated volumes will be compared with volumes forecast in the traffic impact analysis to assess achievement of trip generation conditions. Future roadway volumes will be assessed against future roadway capacity to determine operating conditions. Where deficient conditions occur, the monitoring program will provide information to assess the nature of the deficiencies and to identify measures which may be taken to correct the deficiencies. This information will then be used to update the Access Plan so that it may reflect and respond to conditions as they change over time.

TRANSPORTATION DEMAND AND CAPACITY CHANGES

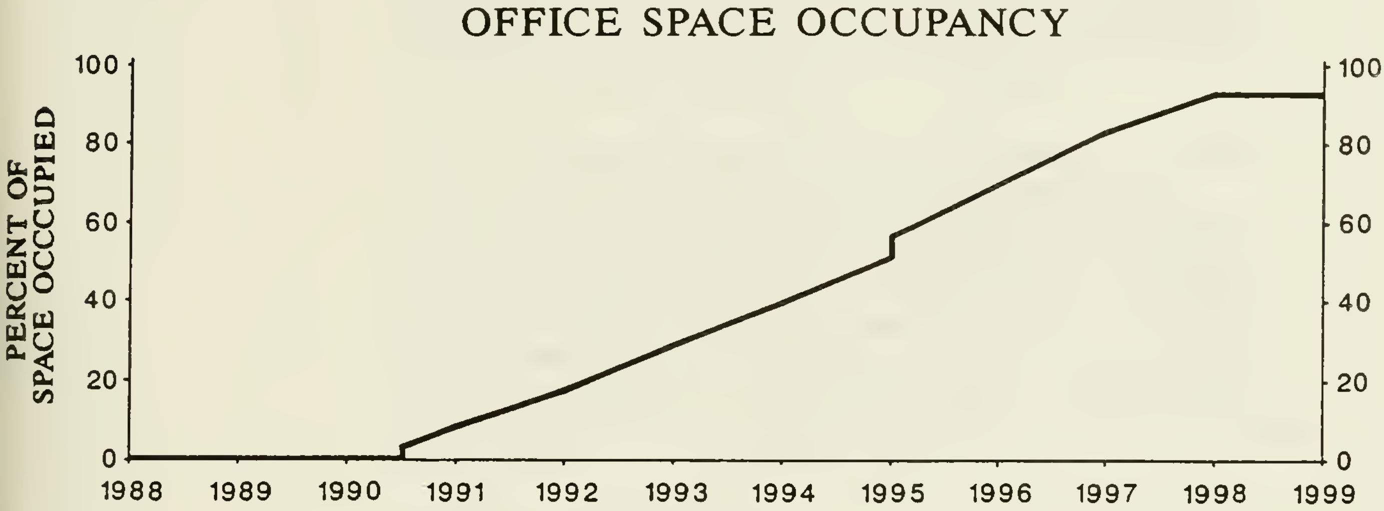
This section is designed to summarize the factors which will affect transportation demand and capacity between now and the 1995 analysis year in the project impact area. Changes in transportation demand, expressed as traffic volume, are the result of new development in the area. Included in this development are the Fan Pier and Pier 4 projects as well as a number of other projects located in South Boston and Downtown. Changes in roadway capacity are a result from improvements or additions to the existing roadway system.

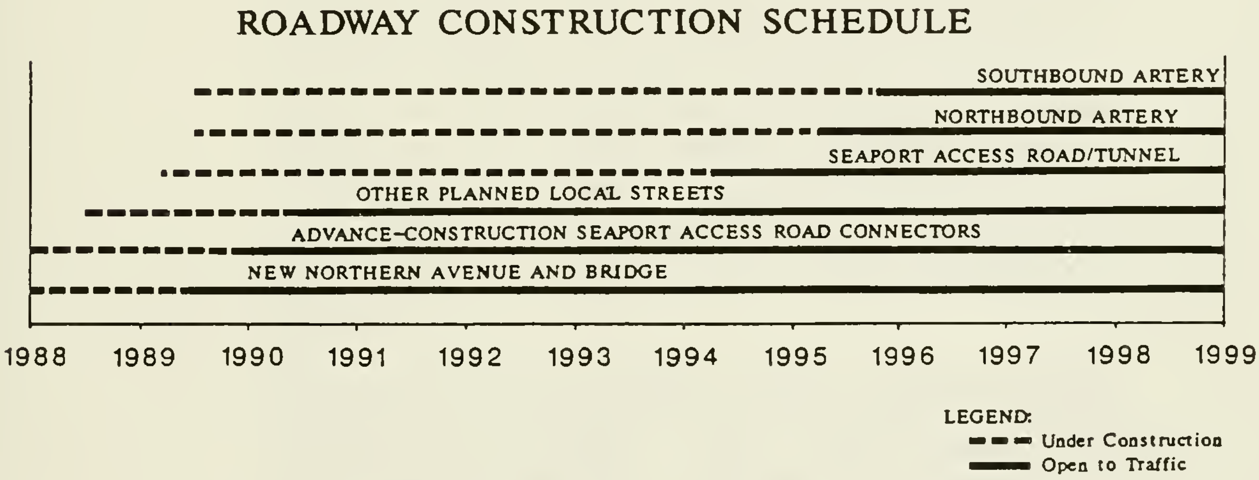
Table 44 shows anticipated background development in South Boston and Downtown through 1995. The traffic expected to be generated by these developments is shown in the Appendix.

Both the Fan Pier and Pier 4 projects are complex construction projects. This fact results in the occupancy and use of their buildings over a long period of time. Figure 25 shows the projected office occupancy of the Fan Pier and Pier 4 developments. The traffic generated by the projects will grow over time in general proportion to the office space occupied (office occupancy accounts for approximately 67 percent of evening peak hour vehicle-trips at full occupancy). Figure 25 also illustrates the timing of projected improvements and additions to the roadway network.

MONITORING PROGRAM GENERAL DESCRIPTION

The monitoring program will consist of two parts: monitoring site generated traffic; and monitoring





Project Office Occupancy and Roadway Improvements Schedule

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Not to Scale

Fig. 25

traffic conditions on study area roadways. The Transportation Management Association (TMA), described in a subsequent section, will be responsible for monitoring site generated traffic and impact area roadway volumes and for reporting the results to the City.

The off-site monitoring effort will commence two years after receipt of PDA approval from Boston Zoning Commission for either project. On-site monitoring for each of the two projects will commence upon occupancy for each respective project. Monitoring will continue until three years after occupancy of the last building in that development. On-site and off-site monitoring will be conducted on a continuing basis. Reporting by the TMA will be done annually, beginning 15 months after the occupancy of the first building.

Each year the TMA will report to the City the volume of traffic generated by the site and the volume of traffic at selected locations along the impact area cordon. For purposes of assessing achievement of goals, the weekday evening peak hour will be reported and analyzed. This report will take the form of a "Supplemental Traffic Access Plan." In addition to reporting observed conditions at monitoring sites, it will also forecast four year projections of site and area traffic volumes. The annual Supplemental Traffic Access Plan will be prepared separately for both the Fan Pier and Pier 4 projects. The scope of the Supplemental Access Plan will include a reanalysis of project-generated travel demands as well as those demands created by other developments in the area. The plan will report on the implementation status of public highway and transit improvements. Finally, the Supplemental Traffic Access Plan will evaluate mitigation measures to minimize impacts.

Based on the traffic impact analysis, which projected operating conditions for both the morning and evening peak hours, the heaviest traffic volumes generally occur in the evening peak hour. In addition, the heaviest project demands are also projected to occur in the evening peak hour. As a result, the monitoring program focuses on traffic leaving the site and the study area in the evening peak hour.

The evening peak hour volumes reported for each location and the sites will be the 85th percentile volumes for the year. The 85th percentile volume is the recorded volume which is equal to or higher than 85 percent of all recorded volumes. Based on approximately 250 work days per year, the 85th percentile volumes will represent the volume recorded on the 38th highest volume workday of the year.

The 85th percentile volume will be used for comparison because it is generally infeasible to provide transportation capacity for the busiest day of the year. Such an approach would involve the unnecessary investment of resources into facilities which would be fully utilized on only a few occasions during the year. Therefore, the design of transportation facilities is based on accepting an overcapacity situation a limited amount of time in order to avoid building capacity in the system which will generally go unused. Use of the 85th percentile day for analysis purposes relates to a system capacity that will accommodate volumes likely to be experienced on most days. The 85th percentile has been historically used by highway agencies as the economical value for highway design purposes.

MONITORING PROGRAM FOR PROJECT TRAFFIC

The purpose of monitoring project generated traffic is to compare actual project trip generation to that which would be expected based on the trip generation assumptions used in the Final EIR and this Access Plan to project future conditions. On an annual basis, the trip generation equations from the traffic impact analysis will be applied to the occupied space in the developments to determine expected traffic volumes from the developments. Actual driveway counts for the developments will be compared with these projected volumes to determine the approximate extent to which the trip generation assumptions correspond to actual trip making behavior. Driveway counts are agreed to be far and away the best measure of traffic volumes generated by the projects. Nevertheless, a small percentage of vehicle-trips destined to the projects may park off-site. As part of the four-year access plan process, the City may require the project proponents to undertake appropriate surveys to measure the total vehicle-trip generation associated with the project.

The trip generation factors used in the traffic analysis include daily person-trip rates, proportion of trips leaving the sites during peak hours, percent of trips using transit, and average number of persons per vehicle. The Appendix contains a detailed discussion of the values used for these various factors for each land use proposed in the developments. Based on the values used, the estimated number of outbound evening peak hour vehicle-trips per unit of development has been calculated for each land use. These are shown in Table 45.

TABLE 45
PM Peak Hour Outbound Trip Generation Rates

Land Use	Rates Fan Pier	 Pier 4
Office	0.50 trips/1,000 SF*	0.61 trips/1,000 SF
Retail	0.28 trips/1,000 SF	0.41 trips/1,000 SF
Hotel	0.23 trips/room	0.23 trips/room
Housing	0.15 trips/unit	0.15 trips/unit

* Square Feet.

The goal is for actual project trips to be equal to or less than the number of trips that would be expected based on the generation rates given above and the amount of occupied space. Because both the Fan Pier and Pier 4 sites have existing land uses which generate traffic, the goals must account for existing activity. In the case of the Fan Pier, the existing commuter parking lot will be replaced by the proposed development. As a result, the new development can generate the same number of trips as the existing parking with no net additional impact on the roadway network. Therefore, the goal for the Fan Pier development is to generate no more traffic than is currently generated by the site or than is expected based on the current level of development and the trip generation rates given in Table 45. In other words, the goal for Fan Pier is the larger of 1) the existing volume of traffic from the site or 2) the projected volume of traffic from the project.

The existing Pier 4 restaurant will remain as part of the Pier 4 development. Therefore, the goal for Pier 4 is to have actual traffic from the site be equal to or less than the sum of the existing Pier 4 traffic plus the projected traffic from the additional development on the site.

The goals for the developments may be summarized as follows:

Fan Pier - PM peak hour outbound vehicle-trips equal to or less than the LARGER of:

1. Existing PM peak hour vehicle-trips out of the Fan Pier parking lot; or

2. Formula based on the FEIR vehicle-trip rates for Fan Pier and the amount of occupied space:

   0.50 x (KSF office) + 0.28 x (KSF retail)
   + 0.23 x (hotel rooms) + 0.15 x (housing units).

Pier 4 - PM peak hour outbound vehicle-trips equal to or less than the SUM of:

1. Existing PM peak hour outbound vehicle-trips from the Pier 4 parking lot; and

2. Formula based on the FEIR vehicle-trip rates for Pier 4 and the amount of occupied space:

   0.61 x (KSF office) + 0.41 (new KSF retail)
   + 0.23 (hotel rooms) + 0.15 (housing units).

The initial step in the project traffic monitoring program is to establish existing evening peak hour outbound volumes from the Fan Pier parking lot and from the Pier 4 restaurant. Counts should be taken on different days of the week during different weeks in the spring and fall to establish average volumes for a typical work day.

The second step will be the installation of automatic counters during project construction. Counters will be installed at all vehicular entrances to and exits from the sites along Old Northern Avenue. Data collection will commence with occupancy of the first building for each of the respective developments. The number of inbound and outbound vehicles at each location will be recorded by direction for each quarter-hour.

Commencing 15 months after occupancy of the first building, the TMA will prepare annually for the City a Supplemental Traffic Access Plan. Included in that report will be the 85th percentile outbound PM peak hour volume recorded during the previous year for the Fan Pier and for Pier 4. Also included in the annual report will be the amount of occupied space or number of occupied units for each land use in each development on the date the 38th highest hourly volume was recorded. Based on the amount of occupied space reported and the formulas presented above, the goals for each development will be calculated and compared to the recorded volumes. The Supplemental Access Plan will also include a four year forecast of project generated demands.

MONITORING PROGRAM FOR IMPACT AREA TRAFFIC

The purpose of monitoring impact area traffic is to identify actual traffic conditions in the area. If traffic conditions decline below acceptable levels, the monitoring program will allow the City to identify specific deficiencies and plan improvements to be undertaken by the City to correct those deficiencies. Improvements to be considered include intersection treatments, corridor changes, or areawide measures to reduce demand.

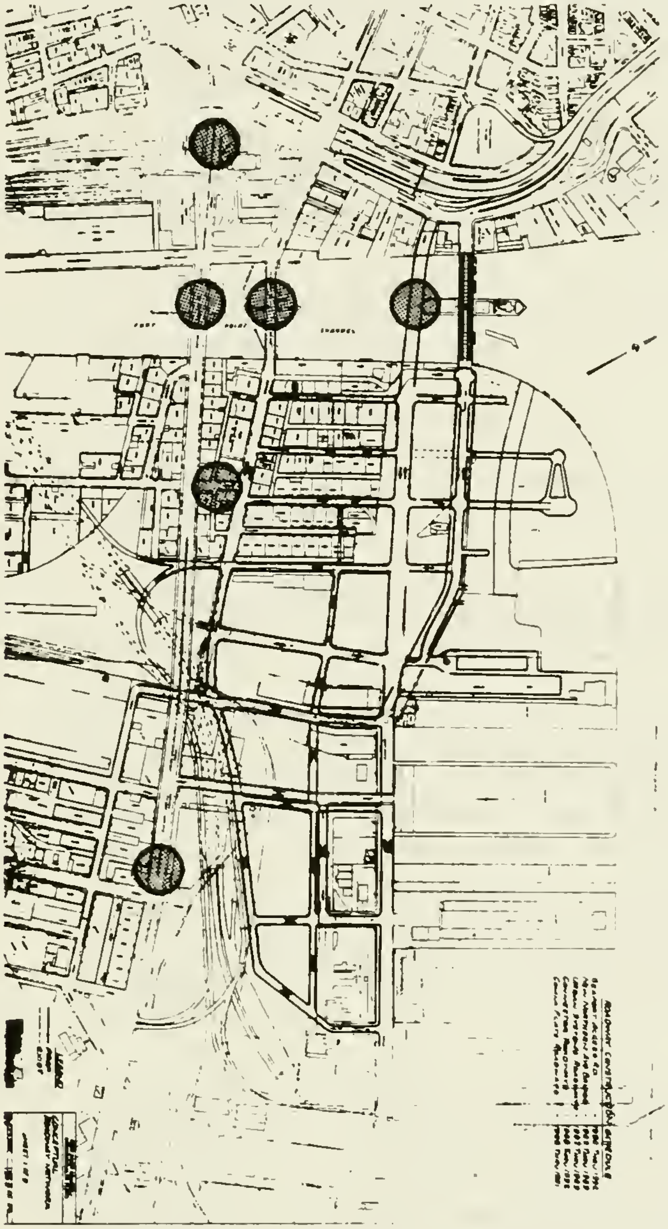
Like the site monitoring program, the areawide monitoring program will focus on traffic volumes exiting the area in the evening peak hour. Key intersection approaches and roadway links across the study area cordon will be monitored. The locations to be monitored are shown in Figure 26 and include:

- New (or Old) Northern Avenue Bridge (westbound approach to the intersection of Northern Avenue and Atlantic Avenue).
- Congress Street Bridge (westbound).
- Summer Street Bridge (westbound).
- Westbound Summer Street approach to Dewey Square.
- Southbound A Street between Congress Street and Melcher Street.
- Eastbound Summer Street approach to D Street.

These locations will provide information about evening peak hour traffic exiting the Northern Avenue development area of South Boston. They will provide volumes across a cordon line along the Fort Point Channel and Summer Street. Included are all major intersections along the cordon line which are impacted in the evening peak hour by traffic from Northern Avenue area development.

Additional off-site monitoring locations at the intersections of the Seaport Access Road connecting ramps with New Northern Avenue may be necessary after these roads are open.

The TMA will fund the installation of permanent volume detection equipment on the identified intersection approaches and roadway links. Installation of the equipment will take place prior to occupancy of the first building (in conjunction with bridge rebuilding or



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Off-Site Monitoring Locations

Not to Scale

Fig. 26

other roadway improvements where possible). The TMA will commence the impact area monitoring program after total exiting traffic from the Fan Pier and Pier 4 sites exceeds volumes currently exiting from the Fan Pier/ Pier 4 parking lots. Volumes will be recorded continuously at 15-minute intervals.

The initial step in the impact area monitoring program will be the establishment of the following existing conditions at the selected intersection approaches and roadways:

1. The evening peak hour approach volume for the 85th percentile weekday;

2. Capacity in vehicles per hour;

3. Green time allocation for signalized intersection approaches; and

4. Stopped delay per vehicle and level of service for signalized intersection approaches based on the information from 1 through 3 above.

As part of the Supplemental Traffic Access Plan, the TMA will annually report to the City the 85th percentile volumes for the previous year for each approach and roadway link being monitored. The 85th percentile volume will be evaluated against the following goals:

1. Stopped delay per vehicle on a signalized intersection approach will not result in deterioration below Level of Service "E" or existing conditions, whichever is worse; or

2. Total approach volume on a roadway link is less than 110 percent of the existing 85th percentile volume.

The calculation of stopped delay per vehicle is based on the allocation of green time to the approach and the capacity of the approach. In order to take account of any changes in these approach characteristics which may have occurred subsequent to the determination of existing conditions, the calculation of stopped delay for the 85th percentile volume will be based on the following:

1. Green time will be the larger of:
    a. existing green time allocated to the approach; or
    b. actual green time allocated to the approach during the monitoring period.

2. Approach capacity will be the larger of:
    a. existing approach capacity; or
    b. actual approach capacity during the monitoring period.

MITIGATION

Results of the monitoring program as reported by the TMA will be used to determine the degree of goal achievement. Should off-site goals fail to be reached, mitigation programs will, under the circumstances set forth below, be implemented by the Fan Pier/Pier 4 developers and the City and State agency responsible for maintenance of the area transportation infrastructure. In broad general terms of mitigation responses to apparent problems, the project developers can be viewed as having control over, and thus responsibility for, project generated travel demands. On the other hand, City and State agencies can more readily exercise control over the supply side of the equation, i.e., capacity of the transportation infrastructure.

Examination of the possible consequences of the on-site demand monitoring and off-site operating conditions monitoring as discussed earlier, indicates four potential results as follows:

	Fan Pier/Pier 4 On-Site Demands	Off-Site Operating Conditions
Case 1	Goal Achieved	Goal Achieved
Case 2	Goal Not Achieved	Goal Achieved
Case 3	Goal Achieved	Goal Not Achieved
Case 4	Goal Not Achieved	Goal Not Achieved

The mitigation efforts expended will depend to a large extent on which case results from the monitoring program. In summary fashion, the following matrix outlines the categories of mitigation approaches which may be appropriate for each of the resultant monitoring cases:

	Fan Pier/Pier 4 Developers	City Agency
Case 1	No Action Necessary	No Action Necessary
Case 2	No Action Necessary	No Action Necessary
Case 3	Mitigate (reduce) Demand Action Required	Increase Capacity Initial Action Required
Case 4	Mitigate (Reduce) Demand Action Required	Increase Capacity Action Required

In both Cases 1 and 2, off-site operating conditions remain equal to or better than predetermined goals, in particular the roadways crossing the cordon line surrounding the project development area remain able to process vehicular demand without failure to achieve reasonable urban area operating conditions during PM peak hours. No action is required in either of these cases.

Cases 3 and 4, where off-site goal failure is reported, requires both project developers and/or government agencies to potentially take action. The initial respondent in Case 3, where on-site respective goals are met, is the City. The first response of the City will be to institute mitigation efforts to increase capacity of the local street system through operational means and to require all members of the TMA which are exceeding their on-site goals to implement mitigation measures intended to conform to all such goals. Should implementation of such measures result in achievement of off-site goals, then, obviously, no further action is required by either the City or TMA members. However, if the City is unable to mitigate operational problems by all practical means of increasing capacity and through requiring conformance with the on-site goals by the TMA members, the project proponent and all TMA members will then be required to reduce demand to the extent the City can allocate responsibility for such off-site goal failure for each TMA member. The degree to which project proponent must mitigate site generated demand will be limited to the degree to which proponent excess traffic contributes to off-site problems. This requires license plate matching studies by the City to determine

percentage and amount of proponent excess traffic passing through the off-site intersection approach which has been identified.

In Case 4, excess traffic demands are observed from the project sites and operating conditions on area roadways are below prestated goals. Project proponents are required here to mitigate demands to bring traffic flow back to on-site goal levels. In this case, no proof of degree of contribution to off-site problems is required, the proponent must achieve its on-site goals. However, the City's responsibility to improve operating conditions back to goal conditions remains. Once the project proponents achieve on-site project goals, the City is responsible for following procedures identified in Case 3.

In cases where project proponent is required to reduce peak hour traffic demands, the proponent may undertake additional studies to determine cause of goal failure. This additional study may include vehicle occupancy counts, employee surveys, or other data collection necessary to determine why the goal has been exceeded. Specifically, the study will be directed at determining which vehicle-trip generation factors are not meeting the Final EIR and Access Plan projections. The proponent will identify the steps to be taken to reduce project generated trips to meet the goal.

Furthermore, in cases where the project proponent is required to reduce peak hour traffic demands, the proponent will take some or all of mitigation measures A through I listed below to the extent necessary to achieve the on- or off-site goals, provided that such measures do not adversely affect financial feasibility of the project. The Authority shall also use reasonable efforts to cause all members of the TMA to implement comparable mitigation measures; if and to the extent the Authority does not impose particular mitigation measures on all members of the TMA, Applicant shall not be required to implement mitigation measures not uniformly imposed.

A. Promotion of flexible work hours for businesses located on the locus.

B. Provision of public transit information, transit pass sales and promotion of employer pass subsidies on the locus.

C. Promotion of ride-share and matching services on the locus.

D. Preferential location for carpool and vanpool parking on the locus.

E. Sponsorship of and differential parking rates for vanpools to and from the locus.

F. Different parking rates for carpool parking on the locus.

G. Provision of land-based facilities on the locus for water taxi/shuttle service to and from the locus.

H. Provision of airport motor vehicle shuttle to and from the hotel on the locus.

I. Differential parking rates on the locus for monthly and daily parking spaces, not available on working days until after 9:30 AM.

After implementation of mitigation strategies A through I, should off-site goals not be attained, then other mitigation measures may be requested by the Boston Redevelopment Authority. If the Authority and the proponent do not agree on mitigation steps to be taken, then the Authority may itself undertake mitigation measures. The project proponents will then, upon request of the Authority, pay to the Authority, in lieu of implementing any additional mitigation measures other than A through I above, which proponent shall continue to be obligated to perform, an amount equal to the sum of a maximum overall payment (the "traffic payment") calculated as 50 cents per square foot of aggregate gross floor area of commercial space in the project, payable in components from time to time to the extent building permits have been obtained for applicable portions of the project less expenses incurred for mitigation measures other than those listed in A through I.

Steps which the Authority will cause the Boston Transportation Department to take to increase capacity and better operating conditions on the existing street system being monitored may include, but not be limited to, the following actions:

- PM peak hour curbside parking restrictions.
- Towing/enforcement of loading and parking controls during PM peak hours.
- Signal retiming at individual intersection.
- Intersection channelization.

- Intersection approach turn lane designations.
- Reversible lane use on Fort Point Channel Bridges.
- Coordinated signal systems on arterial roadways.
- Incident reporting techniques upgraded.
- Quick response methods to incidents.

APPENDIX

CONTENTS

EXISTING STREET SYSTEM

PROJECT TRAVEL DEMAND

BACKGROUND DEVELOPMENT VEHICLE TRAVEL DEMANDS

PROJECT VEHICLE TRIP DISTRIBUTION

TRIP ASSIGNMENT WITH THIRD HARBOR TUNNEL

BACKGROUND DEVELOPMENT TRANSIT TRAVEL DEMAND

DATA COLLECTION ON THE MBTA RED AND GREEN LINES

INTERSECTION ANALYSIS TECHNIQUES

Existing Street System

The following paragraphs describe in detail the major roadway links and intersections which are part of the study area. Descriptions include number of traffic lanes, alignment, traffic control devices, operating characteristics and land use.

1. Roadways

Northern Avenue - Northern Avenue in the vicinity of the proposed project is a two-lane bi-directional roadway running in an east-west direction from Atlantic Avenue and the Central Artery (I-93) to the Boston Marine Industrial Park. Northern Avenue functions primarily as a local collector/distributor road, providing access to the Industrial Park and to other industrial/ commercial development along its length.

The roadway varies in width from 56 to 82 feet and essentially functions as two wide travel lanes separated by a painted double yellow centerline. Pavement condition is basically fair to poor except where the roadway has been recently rebuilt in the vicinity of the World Trade Center. Illumination is provided along the roadway in the vicinity of the project site.

The roadway passes the site on a tangent section over level terrain. Northern Avenue is essentially made up of a series of tangent roadway sections connected by several large radius curves. Lateral obstructions, in the form of signs, utility poles and vegetation, are 2 to 10 feet from the pavement edge.

There are no speed limit signs on Northern Avenue. A number of bus stops are located along Northern Avenue. Metered parking is permitted along both sides of Northern Avenue's western end.

The Northern Avenue bridge across the Fort Point Channel is posted for the following truck weight limits: 9 tons - 2 axles, 12 tons - 3 axles, and 19 tons - 4+ axles.

Congress Street - Congress Street in the vicinity of the site is a two-lane, bi-directional roadway running in an east-west direction from Downtown Boston to B Street in South Boston. Congress Street functions primarily as a local street serving adjacent land uses in the area and providing access to the regional highway system via Atlantic Avenue and the Central Artery.

The roadway varies only slightly in width, essentially consisting of a 52-foot wide paved cross section. There are two through travel lanes in each direction separated by a painted double yellow centerline. Between Atlantic Avenue and A Street, Congress Street consists of three tangent sections with the roadway bending at each end of the Congress Street bridge. The vertical alignment of Congress Street is essentially flat. Lateral obstructions in the form of signs and utility poles are set back 2 to 5 feet from the pavement edge.

Pavement condition is fair with minor breakup of the bituminous concrete roadway surface noticed. Illumination, in the form of mercury vapor lighting mounted on utility poles, is present along Congress Street in the study area. Metered parking is permitted in some sections along both sides of the street. The section between Stillings Street and B Street is an access to several parking areas although the pavement surface is very poor due to cobblestones, railroad tracks, and potholes. The Congress Street Bridge over the Fort Point Channel is posted for the following weight restrictions: 14 tons - 2 axles; 20 tons - 3 axles; 29 tons - 4+ axles.

Summer Street - Summer Street is a four-lane, two-way roadway running in an east-west direction connecting Downtown Boston and South Station with the residential areas of South Boston. Summer Street functions both as a major commuter route and as a collector/distributor of local South Boston traffic, providing access to the abutting industrial uses and to Downtown Boston. South of the Reserved Channel in South Boston, Summer Street becomes L Street.

The roadway varies in width from a 72-foot cross section in the South Station area to a 54-foot cross section in the area of the Reserved Channel Bridge. Pavement markings consist of a double yellow centerline and broken white lane lines. Pavement condition is fair to poor with moderate breakup of the bituminous concrete roadway surface. Roadway illumination is provided by mercury vapor luminaries mounted on utility poles along the edge of the roadway.

The roadway is located on a tangent section over relatively level terrain with the exception of a large radius curve located in the Reserved Channel area. Lateral obstructions in the form of signing and utility poles are placed approximately 2 feet from the pavement edge. Metered parking and several bus stops are located along sections of the street. Vehicular movement is controlled by a series of traffic signals at D Street, Viaduct Street, Dorchester Avenue and Atlantic Avenue. The Summer Street Bridge over the Fort Point Channel is posted for the following weight restrictions: 12 tons - 2 axles, 15 tons - 3 axles, and 19 tons - 4+ axles.

L Street - L Street functions as a local arterial for South Boston, but also carries a substantial amount of regional commuter traffic during peak hours. The southern end of the L Street corridor is characterized by curb parking, pedestrian

activity, and narrow lanes (the street is only 33 feet wide). Parking along both sides of the roadway reduces the effective travelway to only 17 feet. A 17-foot width for two-way traffic flow is generally considered inadequate, particularly when the volume of traffic is heavy. Pavement condition is generally good.

D Street - D Street is a two-lane, bi-directional roadway which connects Summer Street with Broadway, Old Colony Avenue and Dorchester Avenue. This roadway functions as a local connector providing access to the industrial and commercial development along the roadway's northern end. In the vicinity of West Broadway, the roadway features a mix of residential and commercial activity and passes the City's D Street public housing development.

D Street varies somewhat in width but essentially maintains a 30-32 foot paved cross section. Parking is allowed only on the east side of the roadway, but some illegal parking regularly takes place on the west side. With parking on one side only, the available travelway is 22-24 feet wide which is generally adequate. A major problem noted on D Street is the large number of locations where trucking activity conflicts with automobile traffic. The presence of loading docks and tight intersection radii both contribute to delays. Observations of speeds indicate that 25 mph was typical during the morning peak hour, while evening peak hour speeds were considerably lower, averaging 10 mph. The lower travel speeds during the afternoon peak hour are largely the result of truck conflicts and the inability of drivers to pass through more than one traffic signal without stopping. Pavement condition in the southern portion is generally good; in the northern section it is generally fair.

A Street - A Street is a bi-directional two-lane roadway featuring a 34-35 foot pavement width. It experiences a significant amount of truck traffic. A major hindrance to traffic flow is the close spacing of signalized intersections which are not coordinated. Observed peak hour speeds are low, averaging 13 mph during the AM and 6 mph during PM peak hours. Pavement condition is generally fair to poor.

Old Colony Avenue - Old Colony Avenue is a four-lane arterial which functions as a major connector between Morrissey Boulevard and Downtown Boston. It offers direct connections to Dorchester Avenue and D Street. It is primarily commercial in nature; however, some residential properties abut the roadway.

Speed observations on Old Colony Avenue indicate morning peak hour speeds in the vicinity of 28 mph while PM peak hour speeds are lower, at 11 mph. This is primarily attributable to the fact that afternoon peak hour volumes on this roadway are significantly greater than morning peak hour volumes. Pavement condition is generally good.

William J. Day Boulevard - Day Boulevard is a generally east-west roadway connecting Kosciuszko Circle to Fort Independence. It functions both as a commuter route and as a collector for South Boston residents. The road is essentially level with horizontal curves that follow the contours of the harbor.

The roadway consists of a 52 foot wide paved section with two travel lanes in each direction. However, in the vicinity of L Street, parking on the north side limits the two lanes in the westbound direction to one lane. A double yellow centerline separates opposing traffic flows. Illumination is provided and lateral obstructions such as signs, utility poles and vegetation are 1 to 10 feet from the traveled way. Pavement condition is generally good.

Dorchester Avenue - Dorchester Avenue is a two-lane, two-way street running in a north-south direction from Andrew Square to West Broadway in the study area. It provides access to the many businesses along its route and consequently functions primarily as a collector/distributor. Pavement condition is generally fair to good, although a section on the northbound side between Old Colony Avenue and A Street is poor.

2. Intersections

Northern Avenue/Atlantic Avenue - The intersection is located west of the project site just across the Fort Point Channel. Land use in the area is a combination of office and commercial uses. The Central Artery is located west of the intersection parallel to Atlantic Avenue. The intersection of these roadways forms a "T" intersection with a Central Artery on-ramp located directly opposite Northern Avenue and an off-ramp located approximately 300 feet south of the intersection and the on-ramp. A stop sign is posted at Northern Avenue but provides little or no control of heavy peak hour volumes. Lane markings are not present in the intersection and during periods of peak congestion, Northern and Atlantic Avenues both function as three- or four-lane approaches.

Northern Avenue/Ramp Street - This intersection is located east of the project site and is directly south of the Boston Fish Pier. Surrounding land uses are commercial with a variety of restaurants and fish-related industry. The entrance to the Boston Fish Pier is opposite Ramp Street, resulting in an operation similar to a four-legged intersection, with Ramp Street and Fish Pier traffic yielding the right of way to Northern Avenue traffic.

The Ramp Street approach is wide enough to accommodate right and left turn lanes. Parking is permitted on the Ramp Street approach and on both sides of Northern Avenue. Currently, the intersection and a section of Northern Avenue are being reconstructed as part of the development of the World Trade Center at the Commonwealth Pier.

Congress Street at Atlantic Avenue - The intersection of Congress Street at Atlantic Avenue is located west of the site. The Federal Reserve Bank Tower is located in the southeast quadrant of the intersection and the Continental Trailways bus terminal is located in the southwest quadrant of the intersection. A Central Artery northbound on-ramp is located in the northwest quadrant of the intersection. Traffic is controlled by a three-phase traffic signal with a left-turn lag for eastbound Congress Street traffic.

Summer Street at Atlantic Avenue - The intersection has a five-phase (including pedestrian crossings) fixed-time interconnected traffic signal. Summer Street functions as a two-lane approach in each direction with a separate left-turn phase provided for eastbound traffic. Atlantic Avenue becomes one-way north of the intersection and the south leg approaches the intersection with three lanes. Pedestrian activity is high at this intersection with South Station providing access to commuter rail, the Red Line and suburban buses. Bus stops and subway portals are located in the northeast, southeast and southwest quadrants of the intersection. The Federal Reserve Bank is located on the northeast corner and One Financial Center is located on the southwest corner.

Summer Street at Viaduct Street - The intersection of Summer Street at Viaduct Street is located directly south of Commonwealth Pier. Viaduct Street provides a direct connection

to the upper level of the Commonwealth Pier building. Land use at the intersection is primarily office/commercial with the Barnes Building located in the southeast quadrant of the intersection.

The Summer Street/Viaduct Street intersection is a "T" type intersection operating under a two-phase fixed-time signal. Although Viaduct Street is marked for only one lane in each direction, it effectively operates with two approach lanes. Summer Street operates with two travel lanes and one parking lane on both sides.

L Street at East Broadway - The intersection of L Street and East Broadway is located approximately 1-1/2 miles from the project site in the South Boston neighborhood. Land use in the area is a mixture of residential and commercial/retail uses. The intersection functions as a four-way intersection under a five-phase fully-actuated traffic signal controller. All four approaches to the intersection operate with two travel lanes and parking except the westbound approach on Broadway, which has one travel lane. There is a considerable amount of double-parking activity on Broadway.

L Street at William J. Day Boulevard - L Street and William J. Day Boulevard intersect to form a "T" type intersection approximately two miles southeast of the project site. Land use in the area is primarily residential with a recreational use, the L Street Bath House, located at the terminus of L Street.

L Street provides one travel lane and one parking lane in each direction. Day Boulevard is a four-lane facility with two lanes in each direction. On the north side one lane is used for parking. The intersection is controlled by a flashing traffic signal with pedestrian push buttons.

D Street at West Broadway - The intersection of D Street and West Broadway is located approximately one mile south of the project site and one-half mile east of the Red Line Rapid Transit Broadway Station. Residential use is predominant with occasional commercial activity occurring in the vicinity of the intersection.

The D Street and West Broadway intersection functions as a four-way intersection with single-lane approaches on D Street and two-lane approaches on Broadway. Parking is permitted on both sides of West Broadway and on the south side of D Street. Double-parking is prevalent along Broadway. Conflicting traffic movements are controlled by a two-phase, fixed-time, pedestrian-actuated traffic signal.

A Street at West Broadway - The intersection of A Street and West Broadway is a four-way intersection located approximately one mile south of the project site. Land use in the area is a mixture of residential, light industrial, and commercial uses.

The approaches to the intersection each consist of a single travel lane. Parking is located on both sides of West Broadway and on the west side of A Street. Traffic movements are controlled by a two-phase, fixed-time traffic signal with pedestrian actuation.

Bus stops are located on West Broadway west of A Street. The Broadway Red Line station is located one block west of the intersection.

Broadway Bridge at Frontage Road and Albany Street at Herald Street - Broadway Bridge, Frontage Road, Albany Street and Herald Street converge to form two four-legged intersections located on either side of the elevated Central Artery/Southeast Expressway

west of the Broadway Bridge. The Broadway Bridge (east of the Artery) and Herald Street (west of the Artery) consist of two travel lanes in each direction. Frontage Road and Albany Street form a one-way couplet with Frontage Road paralleling the Central Artery in the northbound direction and Albany Street running parallel to the Artery in the southbound direction. Land use along Albany Street is primarily commercial. Traffic is controlled by a multi-phase traffic signal coordinating traffic movements between the two intersections.

West Fourth Street at Frontage Road and East Berkeley Street at Albany Street - West Fourth Street, Frontage Road, East Berkeley Street and Albany Street intersect to form two four-legged intersections underneath the elevated Central Artery/Southeast Expressway west of the Fourth Street Bridge. Land use in the immediate area includes some commercial activity located west of Albany Street.

West Fourth Street is a two-way roadway east of the Central Artery with only the westbound traffic movement permitted underneath the expressway. East Berkeley Street is the extension of West Fourth Street with a one-way westbound traffic flow. Frontage Road and Albany Street form a one-way couplet along either side of the Central Artery. All turn movements between Frontage Road and Albany Street are made possible by two U-turn ramps located north and south of West Fourth Street. Traffic movements are controlled by a three-phase traffic controller coordinating movements between the two intersections.

Dorchester Avenue at A Street and West Fifth Street - Dorchester Avenue, A Street and West Fifth Street intersect to form a four-legged intersection. Land use in the immediate area is retail/commercial with an MBTA maintenance garage located west of Dorchester Avenue. Dorchester Avenue generally consists of

two travel lanes in each direction with parking permitted. A Street and West Fifth Street each carry two travel lanes, one in each direction, with parking permitted on A Street. Traffic movements are controlled at the intersection by a multi-phase interconnected traffic signal with pedestrian actuation.

Old Colony Avenue at D Street - Old Colony Street and D Street intersect to form a four-legged intersection approximately 1-1/2 miles from the project site. Land use in the immediate area is a mixture of strip commercial and residential.

Old Colony Avenue at D Street functions as a four-way intersection with Old Colony Avenue providing two travel lanes in each direction. D Street provides one travel lane in each direction. Conflicting traffic movements are controlled by a three-phase pedestrian-actuated traffic signal.

Andrew Square - Dorchester Avenue, Dorchester Street, Preble Street, Boston Street and Southampton Street converge to form a six-legged intersection. Land use is residential and commercial. The intersection is controlled by a 3-phase fixed time traffic signal. Each approach leg has two lanes with the exception of Dorchester Avenue in the southeast quadrant, which has one approach lane.

A bus and rapid transit station is located on Dorchester Avenue just north of the intersection and bus stops are located on the Preble Street, Southampton Street and Dorchester Avenue approaches. A cab stand is located on the Dorchester Street approach.

Kosciuszko Circle - Columbia Road, Old Colony Avenue, W.J. Day Boulevard and Morrissey Boulevard converge to form a rotary. Columbia Road and Old Colony Avenue have two approach lanes on

the west and north legs, respectively, as do W.J. Day and Morrissey Boulevards on the east and south approaches, respectively. Mount Vernon Street intersects William J. Day Boulevard 300 feet to the east of the rotary. All approaches have yield signs. Land use is primarily transportation related with the Southeast Expressway and Red Line station to the west of the rotary. Paul J. Sanders Stadium is located north of the rotary.

Project Travel Demand

Project travel demand was generated on the basis of trip generation assumptions outlined in the tables below. Table 1 provides daily person-trip rates for office, retail, and hotel land uses. Vehicle-trip rates were used directly for residential uses because no person-trip rate data were available. The office and retail person-trip rates were obtained from the International Place EIR and are based on data from actual surveys and previous studies including "Parking in Central Boston," 1983; "Copley Place Final EIR/EIS," 1980; and "An Access Oriented Parking Strategy for the Boston Metropolitan Area," 1974. The hotel rates were taken from the Traffic Impact Study and Access Plan for Parcel 7 in the Government Center and are based on a survey of the Holiday Inn on Cambridge Street in Boston.

Table 2 shows the mode split factors used for office, retail, and hotel uses. The office and retail work-trip factors for both Fan Pier and Pier 4 and the office and retail non-work trip factors for Fan Pier are those used in the Draft EIR. They reflect a high transit mode share, which is expected to be prevalent in the Northern Avenue area of South Boston as it develops as an extension of Downtown. High transit shares can be expected because of limited availability of parking, the high cost of parking, and good transit connections via a shuttle system to

TABLE 1
DAILY PERSON-TRIP GENERATION RATES

Use	User	In	Out	Total
Office	Work	4.40	4.40	8.80
	Non-Work	2.35	2.35	4.70
	Total	6.75	6.75	13.50
Retail	Work	2.75	2.75	5.50
	Non-Work	16.40	16.40	32.80
	Total	19.15	19.15	38.30
Hotel	Work	1.00	1.00	2.00
	Non-Work	5.94	5.94	11.88
	Total	6.94	6.94	13.88

Source: Office & Retail - International Place EIR
Hotel - Parcel 7 Traffic Impact Study and Access Plan (based on survey at Holiday Inn, Cambridge Street, Boston)

Downtown. Although expected to be relatively high, the projected rates for the Northern Avenue area are below the transit work-trip rates of 70 to 80 percent reported for many Downtown office buildings in "Parking in Central Boston." Because of the Fan Pier's closer proximity to Downtown transit, a somewhat lower transit factor was used for Pier 4 office trips than for Fan Pier. Although some work trips from the projects' residential uses to the office and retail uses are expected, the number is a small proportion of the total work trips and was, therefore, not included as walking trips.

The office and retail non-work trip factors for Pier 4 reflect higher auto usage than for Fan Pier because of the ample supply of short-term parking proposed for Pier 4 (see Parking Impacts under Probable Project Impacts). Hotel non-work rates are based on averages from surveys of the Marriott Long Wharf and Holiday Inn. The higher share of auto trips for hotel work trips compared to retail work trips is based on the dedicated hotel parking provided in each development.

TABLE 2
MODE SPLIT PERCENTAGES

		Mode				
		Auto		Transit		
Use	User	Fan Pier	Pier 4	Fan Pier	Pier 4	Walk
Office	Work*	32%	37%	68%	63%	0%
	Non-Work**	40%	65%	45%	20%	15%
Retail	Work*	15%	15%	85%	85%	0%
	Non-Work***	25%	40%	35%	20%	40%
Hotel	Work***	30%	30%	70%	70%	0%
	Non-Work***	60%	60%	15%	15%	25%

For non-work trips, a significant share of walking trips is expected because of the mixed-use nature of the project. The percentages of office and retail walk trips match the shares used in the International Place, 500 Boylston Street, and Parcel 7 EIRs. The proportion of walking trips for hotel is based on survey results from the Marriott Long Wharf and the Holiday Inn on Cambridge Street.

Table 3 indicates the percentage of daily arrivals and departures expected in the peak hours. The factors for office and retail uses are taken from The Copley Place Final EIR/EIS, while those for the hotel use are based on peak hour person-trips observed at the Marriott Long Wharf. The breakdown between work and non-work hotel trips was based on that used for the Parcel 7 analysis.

The base peak hour factors were modified slightly to generate a small number of outbound work trips in the morning and inbound work trips in the evening. Similar adjustments were made in non-work-rates. These adjustments were based on counts at the Post Office Square Garage and the Fan Pier lot which show some travel in the off-peak direction in the peak hours.

TABLE 3
PERCENTAGE OF DAILY IN AND OUT TRIPS DURING PEAK HOURS

		WORK		NON-WORK	
		AM Peak	PM Peak	AM Peak	PM Peak
Office	In	55%	2%	10%	2%
	Out	1%	55%	1%	10%
Retail	In	10%	10%	1%	5%
	Out	1%	20%	1%	10%
Hotel	In	5%	2%	7%	12%
	Out	1%	6%	8%	9%

Source: Office & Retail - Copley Place EIR.
Hotel - Based on peak hour person-trips for Marriott Long Wharf with work and non-work distribution based on Parcel 7 Traffic Impact Study.

Vehicle occupancy rates are shown in Table 4. The rates for office and retail are the same as those used in International Place, while those for hotel represent averages from the Marriott Long Wharf and Holiday Inn Boston.

TABLE 4
VEHICLE OCCUPANCY FACTORS

Office	Work	1.8
	Non-Work	1.4
Retail	Work	1.4
	Non-Work	1.9
Hotel	Work	1.4
	Non-Work	1.5

Source: Office & Retail - International Place EIR.
Hotel - Marriott Long Wharf and Holiday Inn Surveys.

As noted above, person-trip rates for housing were not available. Therefore, vehicle-trip rates were used directly.

Listed in Table 5 are the rates used, which were taken from the Rowes Wharf EIR and are based on a survey done at Harbor Towers.

TABLE 5
HOUSING VEHICLE-TRIP ENDS PER DWELLING UNIT

Daily	In/Out	3.09
AM	In	0.08
	Out	0.15
PM	In	0.15
	Out	0.15

Source: Rowes Wharf EIR (based on Harbor Towers survey).

All the factors listed in Tables 1 through 5 were combined to generate vehicle-trip generation rates for Fan Pier and Pier 4. These rates are shown in Table 6.

TABLE 6
PROJECT VEHICLE-TRIP GENERATION RATES

	Office*		Retail*		Hotel**		
	Fan Pier	Pier 4	Fan Pier	Pier 4	Fan Pier	Pier 4	Residential
Daily							
In	1.45	2.00	2.45	3.75	2.59	2.49	1.54
Out	1.45	2.00	2.45	3.75	2.59	2.49	1.54
Total	2.90	4.00	4.90	7.50	5.18	4.98	3.08
AM Peak Hour							
In	0.50	0.61	0.05	0.06	0.18	0.17	0.08
Out	0.01	0.02	0.01	0.01	0.19	0.19	0.15
Total	0.51	0.63	0.06	0.07	0.37	0.36	0.23
PM Peak Hour							
In	0.03	0.04	0.14	0.20	0.29	0.29	0.15
Out	0.50	0.61	0.27	0.40	0.23	0.22	0.15
Total	0.53	0.65	0.41	0.60	0.52	0.51	0.30

* Trips per 1,000 square feet.
** Trips per room.
*** Trips per unit.

Background Development Vehicle Travel Demands

Vehicle-trip generation from those background developments for which no traffic projections were available was calculated directly. For downtown developments, trip generation factors used for International Place were applied (see Table 7). In South Boston, four different sets of factors were used depending upon the nature of the background development and its location.

TABLE 7
MODE SPLIT PERCENTAGES FOR
DOWNTOWN BOSTON BACKGROUND DEVELOPMENT

		Percent Trips By		
Use	User	Auto	Transit	Walk
Office	Work	30.0	70.0	0.0
	Non-Work	27.5	57.5	15.0
Retail	Work	30.0	70.0	0.0
	Non-Work	27.5	32.5	40.0

Source: Office & Retail - International Place EIR.

Trip generation factors applied to Fan Pier were used to project Cabot, Cabot & Forbes trips. Factors applied to Pier 4 were used to generate trips for Commonwealth Pier, Pier 6 and Commonwealth Flats. Generation rates for Boston Wharf were based on existing trip generation characteristics for South Boston.

Finally, it was necessary to develop trip generation rates for industrial and manufacturing uses proposed for Boston Marine Industrial Park (BMIP), Gillette, and Wang. The Building 114 EIR used Institute of Transportation Engineers (ITE) rates for light industrial uses modified for South Boston transit usage and vehicle occupancy rates. That same approach was used here with somewhat different rates applied to Downtown and South Boston.

Table 8 shows the ITE industrial rates as well as the industrial rates used for South Boston and Downtown. The ITE rate reflects no transit usage and a vehicle occupancy rate (VOR) of 1.3. The South Boston rates represent a 20 percent reduction of the ITE rates to reflect a 10 percent transit use and a VOR of 1.46 (based on surveys reported in the Building 114 EIR). The Downtown rate represents a 60 percent reduction to reflect 60 percent transit usage and a VOR of 1.42 (based on assumptions used in the 1983 report "Parking in Central Boston").

TABLE 8
INDUSTRIAL BACKGROUND DEVELOPMENT TRIP GENERATION RATES*

	ITE**	South Boston	Downtown
Daily	5.46	4.37	2.02
AM Peak Hour			
In	0.85	0.76	0.35
Out	0.15	0.13	0.06
Total	1.11***	0.89	0.41
PM Peak Hour			
In	0.32	0.32	0.15
Out	0.63	0.63	0.29
Total	1.18***	0.95	0.44

* Trips per 1,000 square feet.

** Institute of Transportation Engineers Code 110.

*** In and Out rates do not add to peak hour totals because the values are based on a different sample of projects. South Boston and Downtown peak hour rates are derived from ITE peak hour totals.

Table 9 lists projected daily and peak hour volumes for each background development. The source of the volumes is given for each development.

TABLE 9
1995 BACKGROUND DEVELOPMENT VEHICLE-TRIP GENERATION

Project	Daily Traffic	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour In	PM Peak Hour Out
South Boston					
1. Commonwealth Pier 5	4,302	623	84	133	567
2. Fish Pier 6	570	105	4	9	103
3. Commonwealth Flats	3,011	542	46	103	509
4. Cabot, Cabot & Forbes	1,503	249	7	16	251
5. Boston Wharf Company*	16	-89	-28	-126	0
6. Gillette	459	80	14	34	66
7. Boston Marine Industrial Park	2,731	475	81	200	394
Downtown Boston					
8. Rowes Wharf	3,340	240	81	126	226
9. International Place	4,656	770	0	18	800
10. 260 Franklin Street	1,162	232	0	0	232
11. 265 Franklin Street	1,248	250	0	0	250
12. One Financial Center	1,850	389	0	0	389
13. Marketplace Center	1,059	283	0	16	327
14. Exchange Place	2,140	751	0	0	751
15. 75 State Street	1,726	252	0	0	252
16. 101 Federal Street	1,334	224	0	4	232
17. 150 Federal Street	1,224	215	0	3	219
18. 99 Summer Street	681	128	3	7	128
19. 101 Arch Street	1,026	145	4	16	158
20. Wang Laboratories	202	35	6	15	29
21. 20 & 21 Custom House Street	634	101	0	3	106
22. Kingston Street/ Bedford Street Garage	1,762	316	0	3	320
23. Lincoln Street/Essex Street Site	937	158	0	3	163
24. 125 Summer Street	1,229	218	0	2	222
25. 125 High Street	3,442	612	17	38	622

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* Negative values represent a reduction in trips resulting from the loss of industrial uses and conversion of the space to other uses.

Sources:
1. Commonwealth Pier 5 EIR
2.-7. Calculated by Vanasse/Hangen Inc.
8. Rowes Wharf EIR.
9.-14. International Place EIR
15. 99 State Street (now 75 State Street) Draft Traffic Impact Study, Vanasse Hangen Brustlin, Inc.
16. Traffic Analyses by HMM Associates.
17. 150 Federal Street Traffic Impact Study, Vanasse Hangen Brustlin, Inc.
18.-20. Calculated by Vanasse Hangen Brustlin, Inc.
21. Milk and Broad Street Development Traffic Impact Study and Access Plan, Vanasse Hangen Brustlin, Inc., May, 1986.
22.-23. Calculated by Vanasse Hangen Brustlin, Inc.
24. 125 Summer Street, Transportation Impact Study and Access Plan, Vanasse Hangen Brustlin, Inc., July, 1986.
25. 125 High Street, Transportation Impact Study and Access Plan, Vanasse Hangen Brustlin, Inc., November, 1986.

In order to account for traffic growth from non-Downtown development or from additional Downtown developments not specifically identified, a generalized growth factor was also used. Past trends in the growth of Downtown traffic were reviewed to determine a growth factor. Cordon Count data for 1982 indicate that the number of privately-owned vehicles entering Downtown in 1982 was 15 percent higher than the number entering in 1972, although the increase in passengers was only 5.5 percent. The larger increase in vehicle crossings was the result of a decline in vehicle occupancy from 1.59 to 1.42 persons per vehicle. For the period to 1995 it was assumed that there would be a somewhat higher rate of growth in passengers but that there would be no further decline in the vehicle occupancy rate. Therefore, a five percent increase in background traffic was used in addition to distributing specific background development volumes to the roadway network.

Project Vehicle-Trip Distribution

The distribution of project vehicle-trips was based on a license plate survey done by the CTPS of the commuter parking lots at Fan Pier and on the Cabot, Cabot & Forbes property just across Northern Avenue from the Fan Pier. The cities and towns of origin were matched with major routes into Boston. The final distribution shown in Table 10 was established by apportioning Boston core trips (nine percent of the total) to all major corridors except the Massachusetts Turnpike for which there is no inbound entrance or outbound exit between Brighton and Downtown. Table 9 compares project trip distribution by route with trip distribution by compass direction from the 1982 Cordon Count and the International Place EIR. The distribution to the south corresponds almost exactly. However, the Fan Pier and Pier 4 distribution is somewhat heavier to the west and lighter to the north. Part of this difference may result from the assignment of

trips from northwestern communities to Route 2 which is listed as a westerly route. Assignment of trips from the south and west to the local South Boston street system was based on the major route into the study area and consideration of the travel times shown in Table 11.

TABLE 10
COMPARISON OF TRIP DISTRIBUTION FROM LICENSE PLATE SURVEY,* AND 1982 CORDON COUNT AND INTERNATIONAL PLACE EIR

License Place Survey		1982 Cordon Count		International Place	
Route	Percent	Direction	Percent	Direction	Percent
Route 1	11	Northeast	14	Northeast	14
I-93 North	14	North	12	North	14
Route 3 North	6	Northwest	10	Northwest	9
Total North	31	Total	36	Total	37
Route 2	8				
Turnpike	15	West	17	West	17
Total West	23	Total	17	Total	17
Boston St./ Dorchester Ave.	2	Southwest	22	Southwest	22
S.E. Expressway	44	Southeast	25	Southeast	24
Total South	46	Total	47	Total	46
TOTAL	100.00	TOTAL	100	TOTAL	100

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* Survey of cars parked at Fan Pier and Cabot, Cabot and Forbes lots.

TABLE 11
TRAVEL TIME SUMMARY

Route	Average Time (min:sec)	Distance (Miles)
Inbound (AM)		
#1 Morrissey Blvd./Day Blvd./L St./ Summer St./Viaduct St./Comm. Pier	12:07	4.8
#2 Morrissey Blvd./Old Colony Ave./ D St./Summer St./Viaduct St./ Comm. Pier	9:32	3.8
#3 Morrissey Blvd./Old Colony Ave./ A St./Congress St./Sleeper St./ Northern Ave./Comm. Pier	14:04	5.0
#4 Southeast Expressway/Frontage Rd./ West Fourth St./A St./Congress St./ Sleeper St./Northern Ave./Comm. Pier	13:56	4.5
#5 Southeast Expressway/Atlantic Ave./ Northern Ave./Comm. Pier	11:47	4.6
Outbound South (PM)		
#1 Comm. Pier/Viaduct St./Summer St./ L St./Day Blvd./Morrissey Blvd.	12:12	4.8
#2 Comm. Pier/Viaduct St./Summer St./ D St./Old Colony Ave./Southeast Expressway	11:46	3.8
#3 Comm. Pier/Northern Ave./Sleeper St./ Congress St./A St./Old Colony Ave./ Southeast Expressway	13:50	5.0
#4 Comm. Pier/Northern Ave./Sleeper St./ Congress St./A St./West 4th St. Bridge/Southeast Expressway	17:12	4.5
#5 Comm. Pier/Northern Ave./Sleeper St./ A St./West Second St./Broadway Bridge/Southeast Expressway	16:23	4.7
#6 Comm. Pier/Northern Ave. Bridge/ Atlantic Ave./Surface Road/Southeast Expressway	22:12	5.3

TABLE 11 (Continued)
TRAVEL TIME SUMMARY

Route	Average Time (min:sec)	Distance (Miles)
Outbound West (PM)		
#1 Comm. Pier/Northern Ave./Atlantic Ave./ Surface Road/Central Artery/Mass. Pike	9:30	1.7
#2 Comm. Pier/Northern Ave./Sleeper St./ Congress St./Dorchester Ave./Summer St./Surface Road/Mass. Pike	18:10	2.7
#3 Comm. Pier/Northern Ave./Sleeper St./ Congress St./A St./West Second St./ Broadway Bridge/Central Artery/ Mass. Pike	9:22	2.4

SOURCE: Field observations made during data collection effort for Commonwealth Pier Five EIR.

Trip Assignment with Third Harbor Tunnel

The traffic analysis was done for future conditions with the proposed Seaport Access Road and Third Harbor Tunnel, but without depression of the Central Artery. The addition of the Seaport Access Road and Third Harbor Tunnel to the network results in a considerable diversion of traffic from the local street system. Each route was analyzed to compare the relative advantage of using the Seaport Access Road/Third Harbor Tunnel versus the local street system. Almost two-thirds of project traffic was projected to use the Seaport Access Road. This diversion is comparable to a projection used by the CTPS in a Northern Avenue analysis done in 1984. Table 12 shows the two distributions.

TABLE 12
PROJECT DISTRIBUTION WITH SEAPORT ACCESS ROAD

	Inbound		Outbound	
Direction	Project	CTPS*	Project	CTPS*
Northern Avenue East	6%	3%	6%	5%
Seaport Access Road	60%	63%	63%	61%
Pittsburg/Sleeper Streets**	9%	6%	4%	6%
Atlantic Avenue South	19%	22%	--	--
Oliver Street	6%	6%	--	--
Atlantic Avenue North	--	--	7%	6%
Central Artery North	--	--	20%	22%
Total	100%	100%	100%	100%

* Northern Avenue Technical Memo 3, Central Transportation Planning Staff, September 24, 1984.

** Sleeper Street will be one-way outbound while Pittsburg Street will be one-way inbound.

Background Development Transit Travel Demand

Future background growth of rapid transit demand was based on all the Downtown and South Boston background developments identified in Table 9 as well as additional developments in Boston outside the Financial District and in Cambridge. All background developments for which rapid transit trips were generated are listed in Table 13. In addition to the demand from these developments an additional one percent growth factor was used to generate 1995 No-Build rapid transit ridership.

Data Collection on the MBTA Red and Green Lines

Objectives

Because of the current shortage of reliable rolling stock on the Red and Green Lines, scheduled frequencies sometimes cannot be achieved during peak hours. To obtain an accurate measure of PM peak hour line capacity for this report, a series of independent observations was made in September and October, 1986.

While the primary objective was to measure capacity, passenger counts were also taken. Those results, which were similar to the MBTA's own ridership data, were used in this report since they were the most recent available point counts on those lines.

Procedures

Red Line ridership was estimated southbound departing from Broadway Station and northbound departing from Park Street Station. Train movements were recorded in both directions at each location. Data collection at both stations took place on September 19, 29 and 30, and on October 1, 2, and 3, between 4:00 and 6:15 PM.

TABLE 13
TRANSIT BACKGROUND DEVELOPMENTS

South Boston

Commonwealth Pier
Fish Pier
Commonwealth Flats
Cabot, Cabot & Forbes
Boston Wharf Co.
Gillette
Boston Marine Industrial Park

Downtown

Rowes Wharf
International Place
260 Franklin Street
265 Franklin Street
One Financial Center
Marketplace Center
Exchange Place
75 State Street
101 Federal Street
150 Federal Street
99 Summer Street
101 Arch Street
Wang Laboratories
Parcel 7
125 Summer Street
20 & 21 Custom House Street
125 High Street
Bedford Street Garage
Essex Street/Lincoln Street Site
500 Boylston Street

Cambridge

University Park
East Cambridge
Kendall Square
Mass Ave. Corridor
Cambridgeport
MIT
Alewife

Green Line capacity and ridership were estimated westbound departing from Arlington Station. Green Line data collection took place on September 22, 26, and 30, and on October 1 and 2, between 4:00 and 6:15 PM.

To assure data quality, comments on the data collection plan's basic elements (e.g., dates, times, locations and procedures) were obtained in advance from the MBTA Operations Department. Data forms were pre-tested at all three locations on September 10, and a pre-test/training session was held on September 17 with the data collectors (all of whom had previous experience with transit data collection).

Results

At all locations, the peak ridership hour was found to be 4:45 to 5:45 PM. For that peak hour on all survey days, southbound throughput at Broadway Station ranged from 76 to 91 in-service cars (on 19 to 23 trains), with an average of 64 cars, while northbound throughput leaving Park Street averaged 61 in-service cars, with similar variance. At Arlington Station, throughput in the peak hour ranged from 52 to 64 in-service cars, with an average of 58. The number of Green Line trains ranged from 33 to 39, with an average of 36.

On days when peak-hour train throughput is very low, passenger throughput during that hour is constrained, and therefore is not an accurate measure of the demand for service. Because it was recognized that a shortage of supply interferes with the measurement of demand, each line's ridership estimates were obtained from the day when its peak hour capacity (i.e., the throughput of cars) was highest.

On the Green Line, LRVs observed to be 100% full were assumed to be carrying 200 passengers, based on information from the MBTA. On the Red Line, the capacity figures used were 232 for the 6-door "Silverbird" cars, and 263 for the 8-door "Bluebird" cars. This resulted in PM peak hour ridership estimates of 7,136 for the Red Line/North, 11,188 for the Red Line/South, and 10,008 for the Green Line/West.

Intersection Analysis Techniques

1. Signalized Intersections

Levels of Service for signalized intersections were determined using the Critical Movement Analysis procedure which relates the lane utilization on each approach to the total capacity of the intersection. The sum of critical volumes for all approaches is compared to the intersection capacity to establish a volume-to-capacity ratio which quantifies the degree of intersection utilization. The capacity of the intersection is the maximum volume of vehicles that may be processed through the intersection from all approaches during a given period of time under prevailing roadway and traffic conditions. The critical lane volume (CLV) is the volume or combination of volumes during each signal phase which utilizes the greatest amount of the available green time. A signal phase is a part of the signal cycle allocated to any single movement or combination of movements.

In a simple four-way intersection in which each street has one phase for all moves in each direction, the critical lane volume is usually the larger of the two sums of the through movements plus the opposing left turn. The critical lane volumes for each phase are summed together and compared to the capacity of the intersection. The resulting volume-to-capacity ratio

establishes the level of service based on the criteria shown in Table 14. The higher the volume-to-capacity ratio, the greater the percentage of green time that will be utilized processing vehicles and the greater the average delay experienced by all vehicles in clearing the intersection. At capacity, all green time is utilized processing vehicles and many vehicles have to wait through more than one light cycle before clearing the intersection. As a result, long queues develop on the approaches as vehicles arrive at a faster rate than they can be processed through the intersection.

TABLE 14
LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

	Maximum Sum of Critical Volumes			
Level of Service	Two Phase*	Three Phase	Four or More Phases	Volume-to-Capacity Ratio
A	900	855	825	0.00-0.60
B	1,050	1,000	965	0.61-0.70
C	1,200	1,140	1,100	0.71-0.80
D	1,350	1,275	1,225	0.81-0.90
E	1,500	1,425	1,375	0.91-1.00

* A phase is the portion of the light cycle allocated to a particular movement or combination of movements. As the number of phases increases, total intersection capacity declines because of lost time between signal changes.

Source: Transportation Research Board, Transportation Research Circular Number 212, Interim Materials on Highway Capacity, Washington, D.C., January 1980.

The capacities shown in Table 14 have been adjusted downward for intersections where exclusive pedestrian phases are provided or where large numbers of pedestrians disrupt traffic flows.

Adjustments were also made for intersections with high percentages of truck traffic. Because of their slower acceleration and reduced maneuverability, fewer trucks than cars can be processed through an intersection.

2. Unsignalized Intersections

In capacity calculations for an unsignalized intersection or driveway, the assumption is made that the major street traffic is not affected by the minor street movements.[1] The capacity of the intersection is a function of: the right turns into the major road; the left turns from the major road; through traffic crossing the major road; left turns into the major road; and the number of acceptable gaps in the through traffic streams which allow turning or crossing vehicles to pass through the intersection. The critical acceptable gap is defined as "that gap for which an equal number of drivers will accept a shorter gap as will reject a longer gap". Based on a gap acceptance function,[2] the capacity of the minor approach to an intersection can be determined. The difference between available capacity and existing demand is defined as reserve capacity and is used as the criterion for determining level of service. Table 15 summarizes the relationship between level of service, reserve capacity and expected traffic delay.

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[1] Transportation Research Board, Transportation Research Circular Number 281, Proposed Chapters For the 1985 Highway Capacity Manual, Washington, D.C., June 1984.

[2] Transportation Research Board, Special Report 165, Traffic Flow Theory, Washington, D.C., 1975.

TABLE 15
LEVEL OF SERVICE CRITERIA FOR
UNSIGNALIZED INTERSECTIONS

Reserve Capacity	Level of Service	Expected Delay To Minor Street Traffic
400 or more	A	Little or no delay
300 to 399	B	Short traffic delays
200 to 299	C	Average traffic delays
100 to 199	D	Long traffic delays
0 to 99	E	Very long traffic delays
*	F	*

* When demand exceeds capacity, severe congestion may result and affect other traffic movements.

Source: Transportation Research Board, Transportation Research Circular Number 281, Proposed Chapters for the 1985 Highway Capacity Manual, Washington, D.C., 1984.

3. Rotaries

Volume-to-capacity ratios for Columbia Circle are based on analyzing the weaving volumes within each weaving section of the rotary. Criteria on which the analysis is based is presented in the Transportation & Traffic Engineering Handbook.[3] The actual or projected volumes were compared to the rotary section capacity and the traffic operation is expressed as a percent of section capacity.

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[3] Institute of Transportation Engineers, Transportation & Traffic Engineering Handbook; 1976.

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